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Grayman (Walter M.), Cincinnati, OH

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CHARACTERIZATION OF THE WATER QUALITY OF THE LOWER MISSISSIPPI RIVER

by

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Contract No. C2211NAST

Project Officer

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16. ABSTRACT

This study was performed to characterize the water quality of the Lower Mississippi River and to survey the available data and methods that may be used for future water quality management studies of this stretch of river. Primary emphasis was placed on the 150 mile highly industrialized portion of the river from Baton Rouge, LA to New Orelans, LA. The concentration of many organic constituents in the river are characterized by significant high frequency, short term variations. A long term trend towards decreasing concentrations of most organics is apparent. There is little correlation of concentrations or joint occurrence between constituents. A wide array of models and methods were identified as potentially applicable to the Lower Mississippi River. These included models composed of water quality and hydraulic modules and model-data base systems linking models, data bases and display modules in an integrated system.

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FOREWORD

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water systems. Under a mandate of national environmental laws, the agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. The Clean Water Act, the Safe Drinking Water Act, and the Toxics Substances Control Act are three of the major congressional laws that provide the framework for restoring and maintaining the integrity of our Nation's water, for preserving and enhancing the water we drink, and for protecting the environment from toxic substances. These laws direct the EPA to perform research to define our environmental probems, measure the impacts, and search for solutions.

The Water Engineering Research Laboratory is that component of EPA's Research and Development program concerned with preventing, treating, and managing municipal and industrial wastewater discharges; establishing practices to control and remove contaminants from drinking water and to prevent its deterioration during storage and distribution; and assessing the nature and controllability of releases of toxic substances to the air, water, and land from manufacturing processes and subsequent product uses. This publication is one of the products of that research and provides a vital communication link between the research and the user community.

This report presents an overview of information on the water quality of the lower Mississippi River and mathematical methodologies that may be used for future water quality management studies of that stretch of the river. The information along with additional studies can provide a link between municipal and industrial wastewater discharges to the receiving waters and the water quality of the same stream used as a raw water source for drinking water.

Francis T. Mayo, Director
Water Engineering Research Laboratory

ABSTRACT

A study was performed to characterize the water quality of the lower Mississippi River and to survey the available data and methods that may be used for future water quality management studies of this stretch of river. Primary emphasis was placed on the 150-mile, highly industrialized portion of the river from the Baton Rouge, Louisiana, area to New Orleans.

Based on previous studies and statistical analyses performed in this study, several observations were made concerning the water quality of the lower Mississippi River. The concentration of many organic constituents in the river are characterized by significant high-frequency, short-term variations. A long-term trend toward decreasing concentrations of most organics is apparent. However, some organics are not following this general trend and are increasing or are showing no long-term variation. There is little correlation of concentrations or joint occurrence between constituents. Based on limited data, the concentrations of organics appear to increase in the vicinity of Baton Rouge relative to the upstream stretch of river, and they decrease below New Orleans. The same data indicate a significant laterial variation in concentrations, with this variation most significant in the vicinity of major point dischargers.

Application of mathematical models in water quality management requires information on in situ water quality, streamflow and stream dynamics, and discharge (loading) data. An extensive data base was established on organic concentrations in the lower Mississippi River based on ongoing monitoring programs by Jefferson Parish, New Orleans, and the State of Louisiana. Streamflow and stream characteristic data in the form of daily streamflow values and time-of-travel and dispersion data were collected from the U.S. Geological Survey and the U.S. Army Corps of Engineers. The primary source of discharge data is EPA Region VI, based on the NPDES permit system. However, this data base is limited because of past discharge permit requirements that did not require industries to report specific organic concentrations.

A wide array of models and methods were identified as potentially applicable to the lower Mississippi River. These included models composed of water quality and hydraulic modules and model-data base systems linking models, data bases, and display modules in an integrated system.

As a result of the study, the following recommendations for future actions were made: (1) that the data base on discharge data for the lower Mississippi River be expanded by requesting EPA Region VI to secure supplemental specific organic discharge data from industries on the river; (2)

that coordination in scheduling, reporting, and quality control among the monitoring programs on the lower Mississippi River be established to assure a consistent and comparable data base; and (3) that requests be made to industries along the river who monitor water quality to provide this information for inclusion in the water quality data base.

This report was submitted in fulfillment of Contract No. C2211NAST by Walter M. Grayman Consulting Engineer under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period October 1983 to September 1984, and work was completed as of September 1984.

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ENGLISH TO METRIC CONVERSION UNITS

cfs x 0.02832 = cu. m/sec.

ft x 0.3048 = m

mile x 1.609 = km

pound x 0.4536 = kg

MGD x 0.0438 = cu. m/sec

Chapter I

INTRODUCTION

The water quality characteristics of surface water used as a source of drinking water is important information for water utilities. This characterization may be used in making decisions concerning modifications in the water treatment process, designing water quality monitoring programs, or identifying desirable reductions in discharges of pollutants to the surface water.

Characterization of water quality takes several forms. When available, in-stream water quality samples may be analyzed to identify spatial and temporal trends and to define the movement and transformation of pollutants in the surface water. Mathematical models operating at a wide range of detail may be applied to address a range of scenarios or "what if" questions. For example, the impact of alternative discharge limitation policies or varying hydrologic conditions may be studied with such models.

A recent U.S. Environmental Protection Agency (EPA) (Reference I-1) study demonstrated the application of a water quality model linked to the Reach File System. The Reach File System is a nationwide computerized data base of stream-related information and application programs maintainted by EPA. This screening model was applied to the lower Mississippi River to characterize the concentrations of organics in the river resulting from point source discharges. This study concluded that the joint use of the Reach File System and a water quality model provided an economic and feasible means of performing such characterization. In a related study, Goodrich and Clark (Reference I-2) demonstrated the applicability of water quality models to the prediction of toxic pollutant concentrations resulting from upstream industrial discharges.

The present study was conducted as a natural extension of the toxic screening application to the lower Mississippi River. Specific areas investigated in this study include (a) further statistical analysis of the water quality data on the Lower Mississippi River, (b) identification of additional sources of data relative to the characterization of the water quality of the lower Mississippi River, and (c) a review of models and methods that may be used in this further characterization.

The information presented here will serve as a source document for further water quality management studies with specific application to the lower Mississippi River.

REFERENCES

I-1. Grayman, W. M., J. E. Sarsenski, P. J. Wehrman, P. D. Koch, "Conceptual Development of a Toxic Screening Model", USEPA, WERL, Cincinnati, OH, 1984.

I-2. Goodrich, J. A. and R. M. Clark, "Predicing Toxic Waste Concentrations in Community Drinking Water Supplies from Upstream Industrial Discharges: A Vulnerability Analysis", USEPA, WERL, Cincinnati, OH, 1983.

Chapter II

SUMMARY AND CONCLUSIONS

SUMMARY

The objectives of the present study were (1) to survey the lower Mississippi River data and information that may be used in the modeling of the river and (2) to perform statistical analyses for further characterizing the water quality of the river. The results of the study are summarized as follows:

- The lower Mississippi River from upstream of Baton Rouge to the New Orleans area is a highly developed and industrialized area. The 150-mile (see English-Metric Unit Conversion Table) stretch of river contains one of the largest concentrations of organic chemical plants in the world, and as a result, it has been a focus of concern and study.

- Application of mathematical modeling and other analysis techniques to evaluate the impact of pollutant discharges on the river requires information in three areas: in-situ water quality, streamflow and stream characteristics, and point and non-point discharge information.

- Water quality sampling data emphasizing the organic chemicals are available from the Louisiana Department of Natural Resources, the New Orleans Water and Sewerage Board, the Jefferson Parish Department of Public Utilities, and potentially from industries along the river. Data are available from some of these sources since 1977, and an on-going data collection and analysis program continues.

- Data on streamflow and stream characteristics are available from the U.S. Geological Survey (USGS), the Corps of Engineers, EPA, and state agencies. These data include daily flow values and time-of-travel and dispersion information.

- The primary source of discharger data is EPA Region VI. These data, collected in conjunction with the NPDES permit system, include both computerized and paper data. Because of the past permit requirements, only limited discharger data on specific organics are available. The current policy concerning permits for the organic chemical industry on the lower Mississippi River is to require aggregate measures of organic pollutants though the permits require industries to save data on specific organics and to furnish the data to EPA upon request.

- Many of the data on water quality, streamflow, and point discharges are available from EPA computerized data bases or from computer files established as part of the present study.

- The water quality of the lower Mississippi River is characterized by significant high-frequency, short-term variations. A general long-term trend toward decreasing organic concentrations in the river is occurring, though some constituents are increasing, and others vary significantly with little apparent trend.

- A wide array of models and methods are available for use in water quality management of the Lower Mississippi River. Such models are composed of water quality and hydraulic components, and they may be linked to data base and display modules to expand the analytical capabilities of the system.

CONCLUSIONS

The lower Mississippi River provides a good framework for demonstrating water quality management, with particular emphasis on the use of surface water as a source of drinking water. The availability of a significant data base and applicable models, and the general interest in identifying water quality problems and proposing mitigating solutions contribute to the applicability of this area to further study in this field.

The following actions should be taken to augment the present data base and support future efforts in the area of water quality management:

- Expand the data base on discharge data for the Lower Mississippi River by requesting EPA Region VI to secure supplemental specific organic discharge data from industries on the river.

- Coordinate scheduling and provide quality control and assurance in the monitoring programs of Louisiana, New Orleans, Jefferson Parish, and others to assure a comparable and compatible water quality data base for modeling efforts. The State should consider modifying its monitoring program to provide greater reporting precision in organic concentrations and to stagger the sampling times to correspond with the approximate travel time between stations.

- Request industries along the river who conduct water quality monitoring and studies to provide this information as part of an overall water quality data base for the lower Mississippi River.

Chapter III

OVERVIEW

The general purpose of this project was to characterize the water quality of the lower Mississippi River and to survey the available methods and data that may be used for future water quality management studies of this stretch of river. Primary emphasis is placed on the highly industrialized stretch of river from the Baton Rouge area to New Orleans and the organic contaminants that are present in the water.

Significant previous study and water quality monitoring has occurred on the lower Mississippi River. This information has been utilized in characterizing the water quality of this portion of the river. The most significant sources of water quality information are the monitoring programs of Jefferson Parish and New Orleans, Louisiana which date from 1977 and 1980 respectively and a monitoring program began in late 1982 by the State of Louisiana involving the routine sampling at 12 stations on the lower Mississippi River. The data collected during these programs was organized and a common, consistent computer data base was established. A range of statistical and graphical analyses were performed on this data base. Included in these analyses were investigations of: lateral and longitudinal variations in water quality, long term and short term temporal trends and variations in water quality, correlations between constituents and comparison between samples obtained from different sources. The insight gained from these analyses in conjunction with observations from previous studies were utilized in the characterization of the water quality of the lower Mississippi River.

Future water quality management studies will require data on water quality, stream flow and stream dynamics, and point source pollutant loadings. Additionally, models and methods utilizing this data to assess the impacts of alternative management plans under varying scenarios are required. Sources of the required data and potential models and methods were surveyed in this study.

Ongoing water quality monitoring programs by Jefferson Parish, New Orleans and the State of Louisiana were identified as the most comprehensive available water quality data bases emphasizing organics. The Corps of Engineers and the U.S. Geological Survey are the primary sources of information related to stream flow and stream dynamics. USEPA Region VI matinains the most comprehensive information on discharges as part of the NPDES permit system. Weaknesses in the data bases were identified and recommended modifications in the various ongoing data collection programs and/or additional sources of data were identified.

A range of water quality models emphasizing organics in a riverine environment were reviewed. Primary emphasis was placed on the use of models within an integrated framework of a modeling and data base system. Several models and methods are available which may be refined or modified based on available techniques for application to the lower Mississippi River.

The lower Mississippi River provides a good framework for the demonstration of water quality management with particular emphasis upon the use of surface water as a source of drinking water. The availability of a significant data base, and the general interest in identifying water quality problems and propsing mitigating solutions contribute to this area as an excellent demonstration situation.

Chapter IV

DATA BASE

INTRODUCTION

Application of mathematical models requires a data base both as a means of parameterizing the model and to verify the results of the modeling. Within the context of the present study, the required data base must include information in three major areas: in-situ water quality, stream-flow and flow dynamics, and point discharger data. Additionally, general geographically referenced information on the river and its environs is required. The sources, types and extent of data in each of these areas that are currently available and/or being collected on an ongoing basis is described in this chapter. Further details on the format in which the data have been stored as part of this project are presented in Appendix A and B.

STUDY AREA DESCRIPTION

The specific area of interest in this study is the mainstem of the Mississippi River between Baton Rouge and New Orleans, Louisiana. Mainstem reaches upstream and downstream of the study area and contributing lateral streams which may impact the study area or for which data relative to the study area are available are also of interest. A map of the study area is presented in Figure IV-1 (a) and a map of the study area with surrounding areas of potential interest is presented in Figure IV-1 (b).

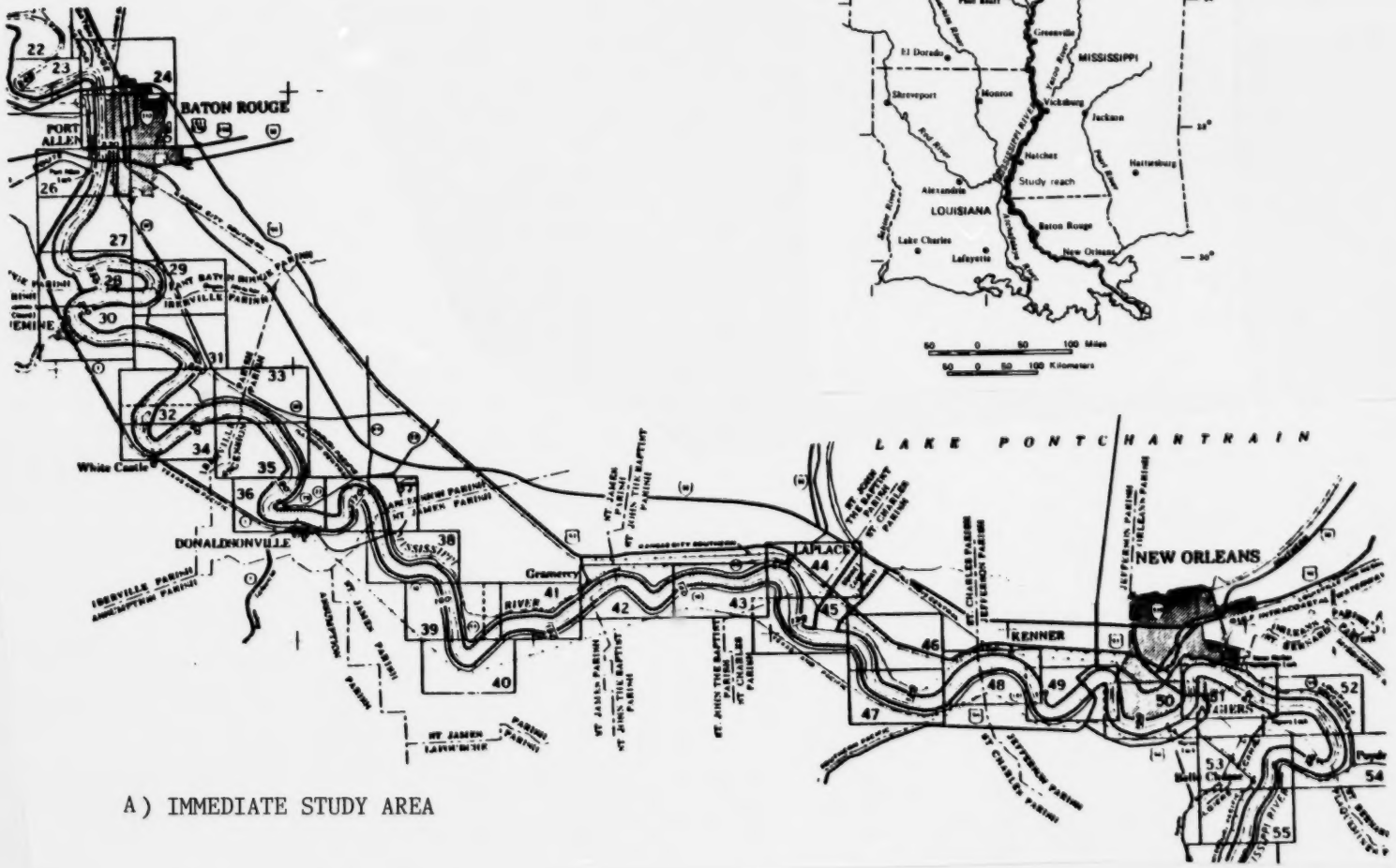
Locations on the Mississippi River mainstem are referenced by a river mile system measured in terms of river miles above the Head of the Passes (AHP), a trifurcation point on the mainsteam in the Mississippi River delta. River miles are identified in the map in Figure IV-1(a). This indexing system is widely used by most governmental agencies. The one major exception to its use is the USEPA Reach File System, which utilizes an internally generated index based directly upon the digitized representation of the river.

The Mississippi River between Baton Rouge and New Orleans is a highly industrialized river. It is utilized extensively as a water supply s e by both municipalities and industries. A list of water intakes, as inventoried by the Louisiana Office of Health Services and Environmental Quality as part of their Waterworks Warning Network is presented graphically in Figure IV-2. Out of the 50 water intakes that are part of the Waterworks Warning Network, 37 supply potable water to approximately 1.4 million people. Major dischargers to the river are discussed later in this chapter.

FIGURE IV - 1

MAP OF STUDY AREA

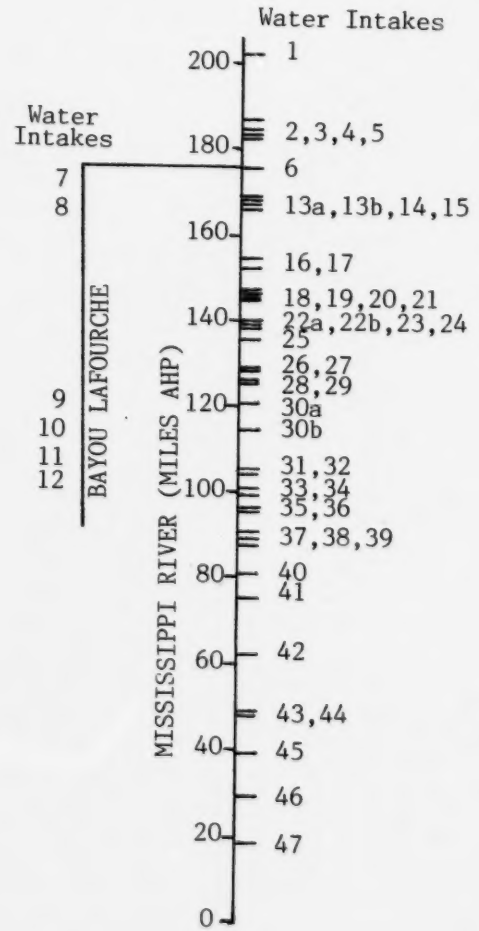
B) VICINITY MAP



A) IMMEDIATE STUDY AREA

FIGURE IV - 2

MAJOR WATER INTAKES ON THE MISSISSIPPI RIVER BELOW BATON ROUGE



		BANK	MILE AHP
1.	Dow Chemical Co., Plaquemine	W	202
2.	Allied Chemical Corp, Geismar	E	187
3.	Borden Chemical, Geismar	E	184.9
4.	BASF Wyandotte Corp., Geismar	E	183.8
5.	Shell Chemical Co., Geismar	E	183
6.	Bayou Lafourche Fresh Water District, Thibodaux	W	175.5
7.	Peoples Water Service Company, Donaldsonville	Intake in Bayou Lafourche	
8.	Assumption Waterworks District #1, Napoleonville	Intake in Bayou Lafourche	
9.	City of Thibodaux Water Plant	Intake in Bayou Lafourche	
10.	Terrebonne Parish Waterworks District #1, Houma	Intake in Bayou Lafourche	
11.	Lafourche Waterworks #1, Lockport	Intake in Bayou Lafourche	
12.	Lockport Water Treatment Plant, Lockport	Intake in Bayou Lafourche	
13a.	Ormet Corporation, Burnside	E	169.5
13b.	E. I. duPont deNemours and Company, Convent	E	169.2
14.	Texaco, Inc., Convent	E	168.1
15.	Agrico Chemical Co., Burnside	W	166.9
16.	St. James Waterworks #1, Convent	E	154.1
17.	St. James Waterworks #2, Vacherie	W	152.2
18.	Town of Lutcher	E	147.4
19.	Town of Gramercy	E	146.7
20.	Colonial Sugar Company, Gramercy	E	146.3
21.	Kaiser Aluminum & Chemical Co., Gramercy	E	145.4
22a.	Marathon Oil Company, Garyville	E	140
22b.	St. John Waterworks #3, Garyville	E	139.3
23.	St. John Waterworks #2, Edgard	W	139.3
24.	Godchaux-Henderson Sugar Co., Inc., Reserve	E	138.6
25.	E. I. duPont deNemours & Co., Laplace	E	136
26.	Hooker Chemicals and Plastics, Taft	W	129
27.	Union Carbide Corporation, Taft	W	128.5
28.	Shell Oil Company, Norco	E	126
29.	St. Charles Waterworks #1, New Sarpy	E	125.1
30a.	St. Charles Waterworks #2, Luling	W	120.6
30b.	American Cyanamid Company, Westwego	W	114.6
31.	Jefferson Waterworks #1, Metairie	E	105.4
32.	Carrollton Plant, New Orleans	E	104.7
33.	City of Westwego Water District, Westwego	W	101.6
34.	Jefferson Waterworks #2, Harrero	W	99.1
35.	City of Gretna Water District	W	98.7
36.	Algiers Plant, Algiers	W	95.8
37.	Amstar Corp., New Orleans	E	90.8
38.	Kaiser Aluminum and Chemical Corp., Chalmette	E	89.3
39.	St. Bernard Waterworks #1, Chalmette	E	87.9
40.	Delcour Waterworks District, Braithwaite	E	80.9
41.	Belle Chasse Waterworks District, Belle Chasse	W	75.8
42.	Gulf Oil Co. - Alliance Refinery, Belle Chasse	W	62.6
43.	Pointe-a-la-Hache Water District	E	49.2
44.	Port Sulphur Waterworks District	W	49.0
45.	Freeport Sulphur Co., Port Sulphur	W	39.4
46.	Buras Waterworks District, Empire	W	29.9
47.	Boothville-Venice Waterworks, Venice	W	10.6

Source: Reference IV-15

WATER QUALITY

In-situ water quality data on the Lower Mississippi River is routinely collected by several governmental agencies and water utilities. Additional data have been collected as part of special studies or by industries using the river as a source of water supply or as a discharge location. The type, extent, and availability of these data are described in this section. The location of each data source on the Mississippi River is shown in Figure IV-3.

Jefferson Parish Department of Public Utilities

The Department of Public Utilities for Jefferson Parish, Louisiana, operates two water treatment plants on the Mississippi River. The Jefferson Parish Waterworks No. 1 at Metairie (River Mile 105.4) performs extensive routine sampling of the raw water and was the site of a USEPA-sponsored project during which an extensive data base of water quality information was compiled. During the conduct of the study on the use of granular activated carbon adsorption, from 1977 to 1979, over 34,000 separate laboratory analyses were performed on the raw water source. (Reference IV-1) A total of 155 different forms of analyses, as listed in Appendix A, were performed on different sub-sets of the samples.

Subsequent to the study and on a continuing basis, Jefferson Parish performs routine sampling on the raw water supply at both the Metairie Plant and at Jefferson Parish Waterworks No. 2 at Marrero (River Mile 99.1). Sampling and laboratory analyses are performed weekly for both volatile organics and non-volatile organics. Organics are analyzed using the purge and trap method, a GC packed column and electrolytic conductivity detector. Neutral extraction is used in the analysis of non-volatiles.

Sewerage and Water Board of New Orleans

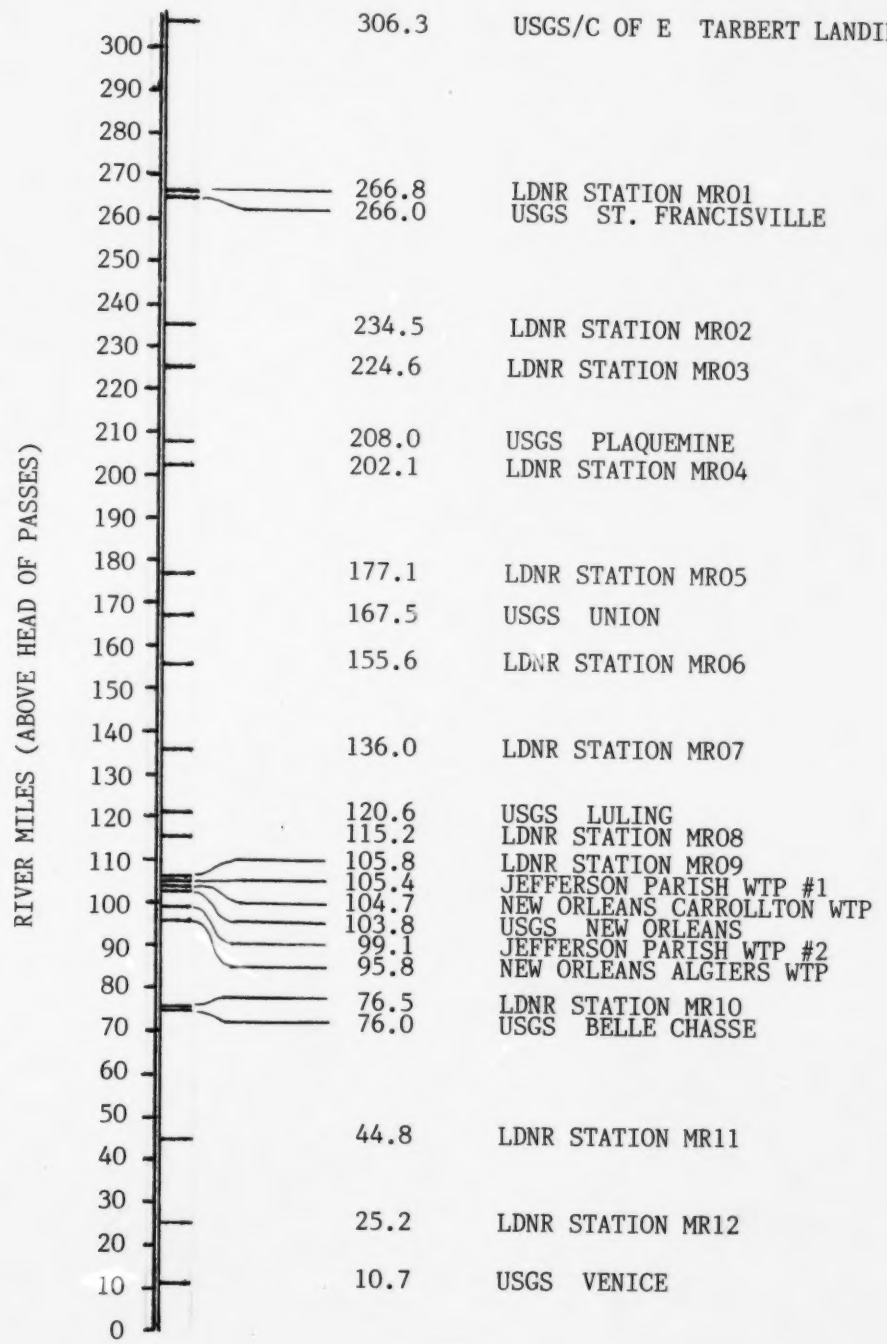
The Sewerage and Water Board of New Orleans operates two water treatment plants with intakes from the Mississippi River, the main Carrollton plant (R.M. 104.7), and the smaller Algiers plant (R.M. 95.8). Sampling of the raw water for various organics has been performed since mid-1980 at the Carrollton Plant on a daily or near daily basis. The concentration on the following six organic constituents has been acquired and stored in a computerized data base for the period from September 1980 to December 1983.

- Carbon Tetrachloride
- Chloroform
- Trichloroethene
- Bromodichloromethane
- 1,2 - Dichloroethane
- Dibromochloromethane

The methods currently utilized in the measurement of organics by the Sewerage and Water Board of New Orleans are concentration by the purge and trap method, separation by a gas chromatograph packed column and detection

FIGURE IV - 3

WATER QUALITY SAMPLING STATIONS



by a Hall Electrolytic Conductor Detector and a Photo Ionization Detector. Sampling and analysis are currently performed daily at the Carrollton plant and weekly at the Algiers plant for the following organic constituents:

Total Organic Carbon
Purgable (Volatile) Organic Carbon
Bromodichloromethane (THM)
Bromoform (THM)
Carbon Tetrachloride
Chloroform (THM)
Dibromochloromethane (THM)
1,2 - Dichloroethane (Ethylene Dichloride)
1,2 - Dichloropropane
Methylene Chloride
1,1,2,2 - Tetrachloroethane
1,1,2 - Trichloroethane
Acenaphthylene
Benzene
Chlorobenzene
1,2 - Dichlorobenzene
1,3 - Dichlorobenzene
Fluorene
Isophorene
Naphthylene
Nitrobenzene
Phenanthrene
Pyrene

Additionally, the capability exists and a periodic sampling analysis is performed for the following phenolics:

4-Chloro-3-Methylphenol
2-Chlorophenol
2,4 - Dichlorophenol
2,4 - Dinitrophenol
2,Methyl-4,6-Dinitrophenol
2-Nitrophenol
Pentachlorophenol
2,4,6-Trichlorophenol
Phenol

Routine analysis is also performed for a wide range of metals and inorganics, and selected microbiologic indicators.

Louisiana Department of Natural Resources (LDNR)

The Louisiana Department of Natural Resources (LDNR) has recently (December 1982) begun an organics sampling program. Sampling is performed from two boats with a frequency of approximately weekly at 10 stations, and biweekly at an additional two stations. Samples are currently taken at midstream and near the left and right banks. The sampling locations and the starting date for each station is presented in Table IV-1.

TABLE IV-1

LOUISIANA DEPARTMENT OF NATURAL RESOURCES (LDNR) ORGANICS SAMPLING STATIONS

Station Descriptions

MR01 - Mississippi River, approximately 1.0 mile upstream from the mouth of Bayou Sara (mile 266.8 AHP) Starting date: December 1982.

MR02 - Mississippi River at the Scott Bluff light and Wilkinson Point (mile 234.5 AHP) Starting date: January 1983.

MR03 - Mississippi River, approximately 3.5 miles downstream from the Port Allen Locks at the Arlington light (mile 224.6 AHP) Starting date: December 1982.

MR04 - Mississippi River, immediately upstream from Point Pleasant at the Bayou Paul light (mile 202.1 AHP) Starting date: January 1983.

MR05 - Mississippi River, approximately 1.5 miles upstream from the Bayou Lafourche intakes at the Smoke Bend light (mile 177.1 AHP) Starting date: December 1982.

MR06 - Mississippi River, at the Chotin Light and College Point (mile 155.6 AHP) Starting date: December 1982.

MR07 - Mississippi River near Lucy, LA at the Godchaux Light (mile 136.0 AHP) Starting date: August 1983.

MR08 - Mississippi River near St. Rose, LA at the Fairview Light (mile 115.2 AHP) Starting date: August 1983.

MR09 - Mississippi River, approximately 0.5 miles downstream from the Huey P. Long Bridge in Jefferson Parish (mile 105.8 AHP)- Starting date: August 1983.

MR10 - Mississippi River, near Belle Chasse, LA (mile 76.5 AHP) Starting date: August 1983.

MR11 - Mississippi River, near Diamond, LA across from the Socola Canal (mile 44.8 AHP) Starting date: September 1983.

MR12 - Mississippi River, near Buras, LA approximately 0.5 miles downstream from the Ostrica Locks (mile 25.2 AHP) Starting date: September 1983.

Samples are analyzed for 29 constituents, as follows, using a purge and trap concentration method in conjunction with a gas-chromatograph-mass spectrometer (GC-MS).

Acrolein
Acrylonitrile
Benzene
Bromodichloromethane
Bromomethane
Chlorobenzene
Chloroethane
2-Chloroethyl vinyl ether
Chloromethane
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane (EDC)
1,1-Dichloroethene
t-1,2-Dichloroethene
Dichloroethane
1,2-Dichloropropane
c-1,3-Dichloropropene
t-1,3-Dichloropropene
Ethylbenzene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Tetrachloromethane
Toluene
Tribromomethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichloromethane (Chloroform)
Vinyl Chloride

U. S. Geological Survey (USGS)

The USGS maintains several sampling stations on the Lower Mississippi River. The location, sample types, and sampling frequency are presented in Table IV-2 (Reference IV-2). Though little sampling for organics is performed by USGS, the extensive sampling program for other constituents, such as solids and inorganics, may be useful in the analysis of the river and its dynamics.

Other Sources of Water Quality Data

The previously described sources of data constitute the primary sources of readily available data on organics in the Lower Mississippi River. Other sources of data are described in the State of Louisiana's Water Quality Management Plan for the Mississippi River Basin (Reference IV-3), and in the USEPA STORET System. Agencies referenced in these sources include the Louisiana Wildlife & Fisheries Commission and the Louisiana Department of Health.

TABLE IV - 2

USGS WATER QUALITY SAMPLING STATIONS

River Mile	Station Name Station Number	Daily Measurements					Other
		Sediment	Spec. Cond.	Temp.	Chloride	Dissolved Solids	
306.3	Tarbert Landing,MS 07295100	X					
266.0	St.Francisville,LA 07373420		X	X	X	X	Monthly: Selected inorganics, metals, pesticides Aperiodic: Selected organics
208.0	Plaquemine, LA 07374120						Monthly: Selected inorganics, metals
167.5	Union, LA 07374220						Monthly: Selected inorganics, metals
120.6	Luling, LA 07374400						Monthly: Selected inorganics, metals Aperiodic: Selected organics
103.8	New Orleans, LA 07374508		X	X			Daily: Dissolved Oxygen, pH Aperiodic: Selected inorganics, metals, pesticides
76.0	Belle Chasse, LA 07374525		X	X	X	X	Aperiodic: Selected inorganics, metals, pesticides, organics
10.7	Venice, La. 07374550						Monthly: Selected inorganics, metals Aperiodic: Selected pesticides, organics

A potentially valuable source of data on organics in the river is private sampling programs conducted by major industries which either use the river as a source of water supply or discharge effluent to the river. These data are not public information, but may potentially be acquired through requests to the industries.

STREAMFLOW AND FLOW DYNAMICS

Streamflow quantities and distributions and characterization of the flow dynamics are essential information in determining the fate of pollutants within the Mississippi River.

The major source of streamflow information is the elevation and discharge measurements made at the Tarbert Landing, Mississippi gage located at river mile 306.3. This gage is 8.2 miles downstream of the inlet channel to the Old River Control Structure where approximately 30% of the streamflow in the Mississippi River is diverted to the Atchafalaya River Basin. The gage is maintained by the Corps of Engineers, and elevation measurements taken every three days. Daily flow is estimated from these measurements and published by USGS on a yearly basis (Reference IV-2). Continuous flow records have been published by USGS since 1972, and are available in Corps of Engineers' reports dating back to 1936.

Since there are no major tributaries to the Mississippi River below the gage, the measurements may be used to estimate flow in the New Orleans areas. Travel time for the flood waves from the gage to New Orleans is generally 12 to 24 hours (References IV-4, IV-5).

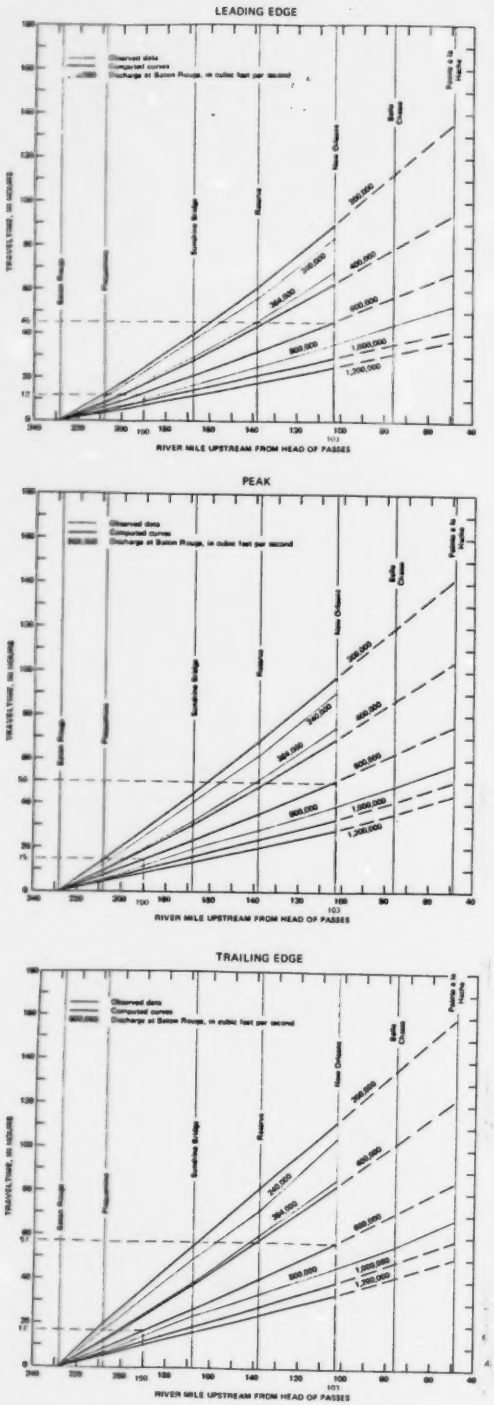
The U. S. Geological Survey in cooperation with the Louisiana Department of Public Works has performed several studies aimed at identifying the time-of-travel and dispersion characteristics of solutes in the Lower Mississippi River. Based on dye tracer studies performed in 1965 (Reference IV-6), 1969 (Reference IV-7), 1974 (Reference IV-8), and 1975 (Reference IV-9), USGS has estimated travel time and dispersion characteristics under varying flow conditions from the Arkansas-Louisiana state line (River Mile 507) to Point A La Hache, Louisiana (River Mile 49). Estimated travel times for the leading edge, peak and trailing edge of a tracer cloud below Baton Rouge are shown graphically in Figure IV-4. A nomograph for predicting the peak concentration of a conservative contaminant at downstream sites based on discharge, travel time, and the quantity of pollutant is presented in Figure IV-5 (Reference IV-8). Similar plots for the river upstream of Baton Rouge are available (Reference IV-9).

Lateral and vertical dispersion were investigated in both the 1969 study and the 1974 study. The variation in lateral concentrations resulting from tracer injections at mid-stream and near the stream banks is shown in Figure IV-6. In the 1974 study, samples were taken near the surface and at a 50-foot depth downstream of the tracer injection. Significant vertical variations were found five miles below the injection site, but almost complete vertical mixing occurred by 17 miles below the injection site. In studies above Baton Rouge, similar lateral variations were observed (Reference IV-9). Observations by LDNR personnel of pollutant traces travelling in the vicinity of river banks rather than homogeneously dispersing across the full width of the river, support the potential lateral variation in concentrations (Reference IV-10).

FIGURE IV - 4

TRAVEL TIME OF SOLUTES

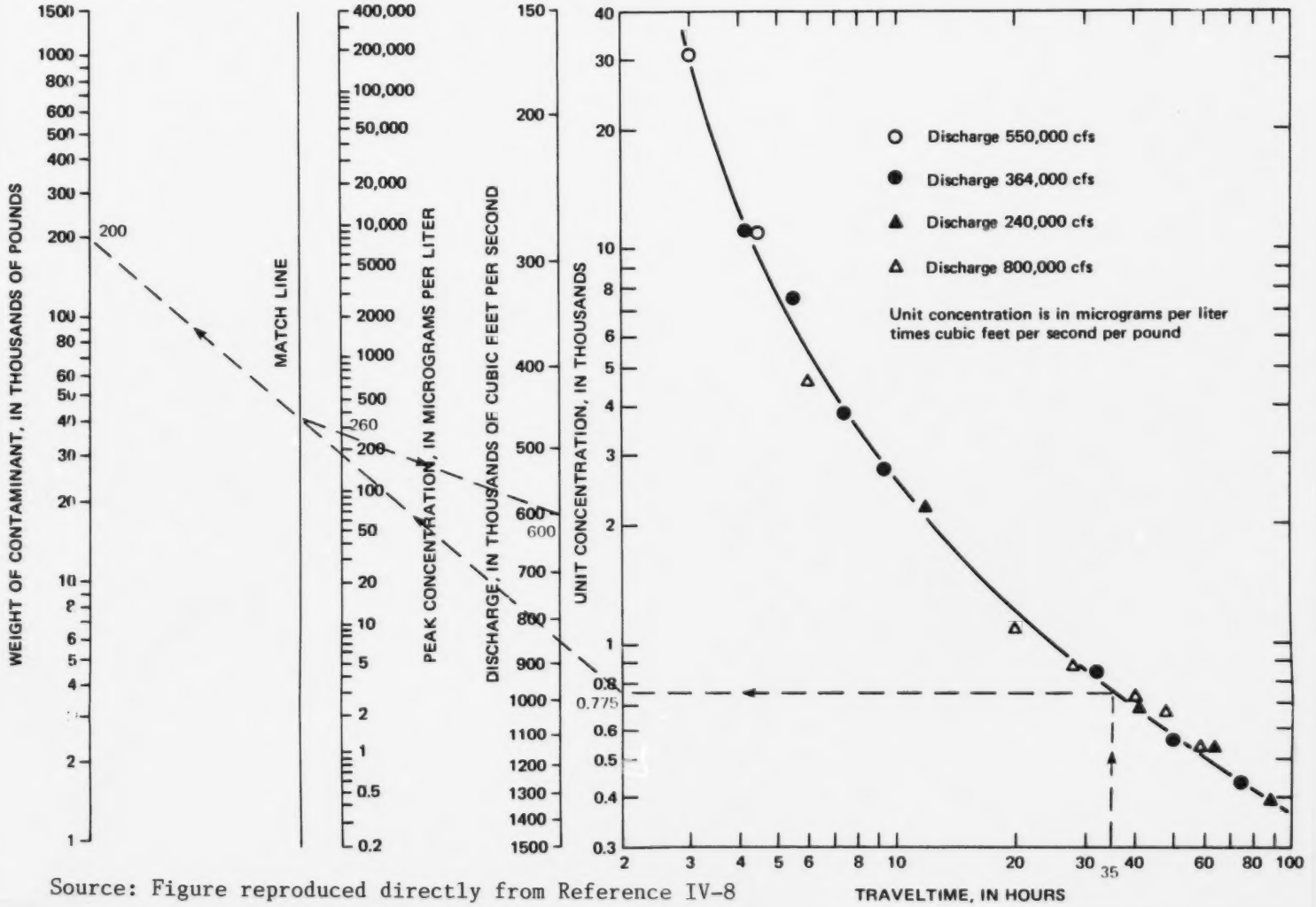
IN MISSISSIPPI RIVER



Source: Figure reproduced directly from Reference IV-8

FIGURE IV - 5

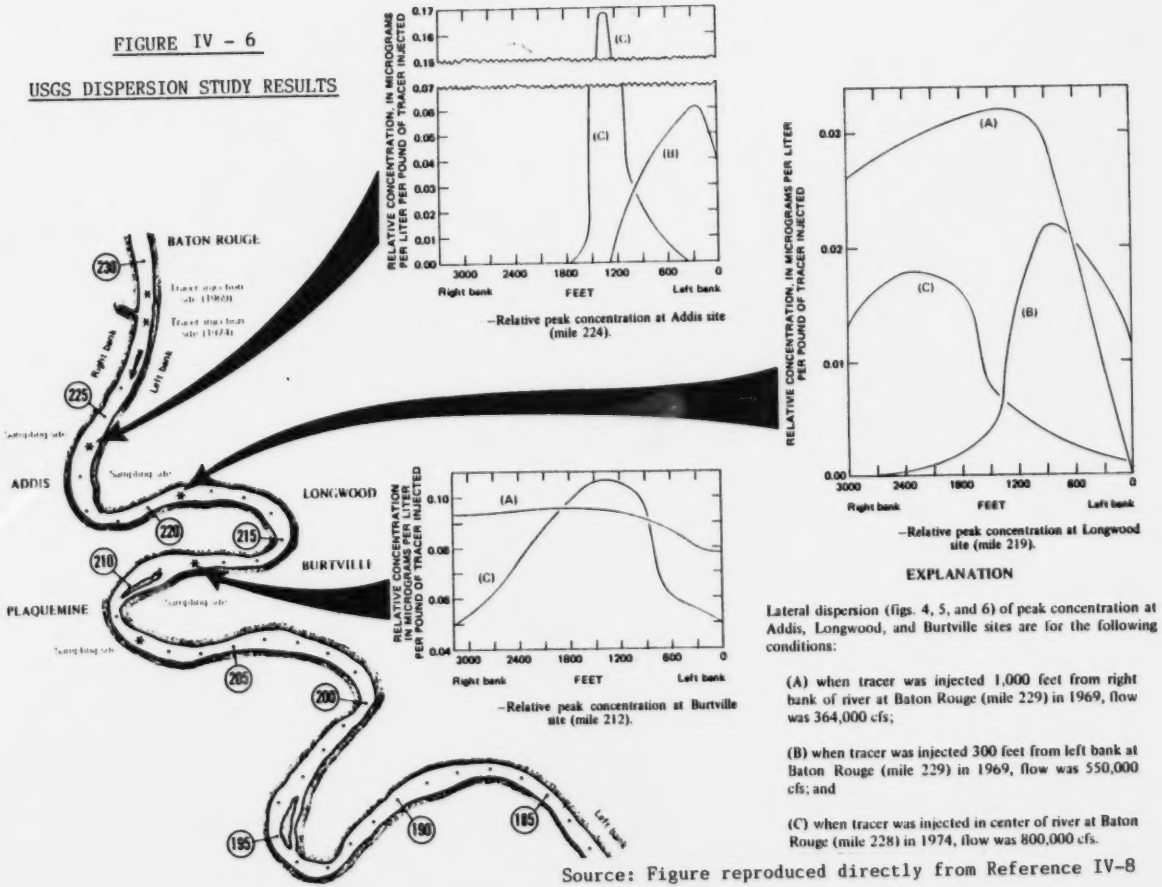
NOMOGRAPH FOR PREDICTING DOWNSTREAM PEAK CONCENTRATIONS OF A CONSERVATIVE CONSTITUENT



Source: Figure reproduced directly from Reference IV-8

FIGURE IV - 6

USGS DISPERSION STUDY RESULTS



–Relative peak concentration at Addis site (mile 224).

–Relative peak concentration at Longwood site (mile 219).

–Relative peak concentration at Burtville site (mile 212).

EXPLANATION

Lateral dispersion (figs. 4, 5, and 6) of peak concentration at Addis, Longwood, and Burtville sites are for the following conditions:

(A) when tracer was injected 1,000 feet from right bank of river at Baton Rouge (mile 229) in 1969, flow was 364,000 cfs;

(B) when tracer was injected 300 feet from left bank at Baton Rouge (mile 229) in 1969, flow was 550,000 cfs; and

(C) when tracer was injected in center of river at Baton Rouge (mile 228) in 1974, flow was 800,000 cfs.

Source: Figure reproduced directly from Reference IV-8

DISCHARGER DATA

The primary source of discharge information is data collected by USEPA in the process of issuing or monitoring an NPDES (National Pollutant Discharge Elimination System) permit. For the State of Louisiana, permits are issued and monitored by USEPA Region VI in Dallas. The permit issuance and monitoring process is shown schematically in Figure IV-7, and described in more detail in the following paragraphs.

NPDES permits are written based on Federal regulations and guidelines, information provided by the permittee in their permit application, and other hydrologic, economic, water quality, and treatment technology information available to the permit writer. Some information submitted by the permittee or otherwise available to the permit writer is considered confidential and not available to the public. A significant source of discharger data is the Form 2C that must be submitted with a permit application or renewal information. These forms contain the concentrations of all conventional and priority pollutants in waste water at the plant's outfall. In a recent study for USEPA (Reference IV-11), the information on concentration of selected organics for 10 selected major industries in the "Organic Chemical, Plastics and Synthetic Fibers" (OCPSF) category was collected from Form 2C. This information is summarized in Table IV-3.

As part of the permit-writing process, permitted facilities are classified as major or minor facilities, based on a scoring system considering the type, amount, and quantity of pollutants discharged, the receiving stream characteristics, and potential public health impacts. For major facilities, permit information is entered into a computerized system called the "Permit Compliance System" (PCS). There are currently 93 major facilities located on the Lower Mississippi River. A list of these facilities is presented in Table IV-4 based on information from PCS. The location (river mile) is not stored in PCS, and has been acquired from other sources (Ref. IV-3, IV-11) where available. Major permittees are required to submit quarterly Discharge Monitoring Reports (DMR) based on the sampling requirements in their permit. This report will become a monthly requirement in the near future. Information from the DMR is input into the PCS and various reports are generated. Examples of a permit summary report and a violations report generated by PCS are presented in Figures IV-8 and IV-9, respectively. DMR information is available since June 1982 on PCS. Prior to this time, DMR information is available on microfiche with some reports dating back to 1974.

In general, in the past, few industries have been required to sample for specific organic compounds resulting in relatively little discharge data on organics. In the past few years, many of the permits written for the organic chemical industries have required the industries to report organic concentrations in terms of aggregate organic indices such as total purgeable halocarbons and total purgeable aromatics (Reference IV-12). In the calculation of such aggregate industries, measurements of the individual compounds are made and mathematically summed. The industries are required to save those indiviual measurements and USEPA may request them for a period of up to three years. Thus, though an extensive data base on organic chemicals in discharges is not currently available, a mechanism for obtaining the data is available.

FIGURE IV - 7

SCHEMATIC REPRESENTATION OF NPDES PERMIT ISSUANCE / MONITORING PROCESS

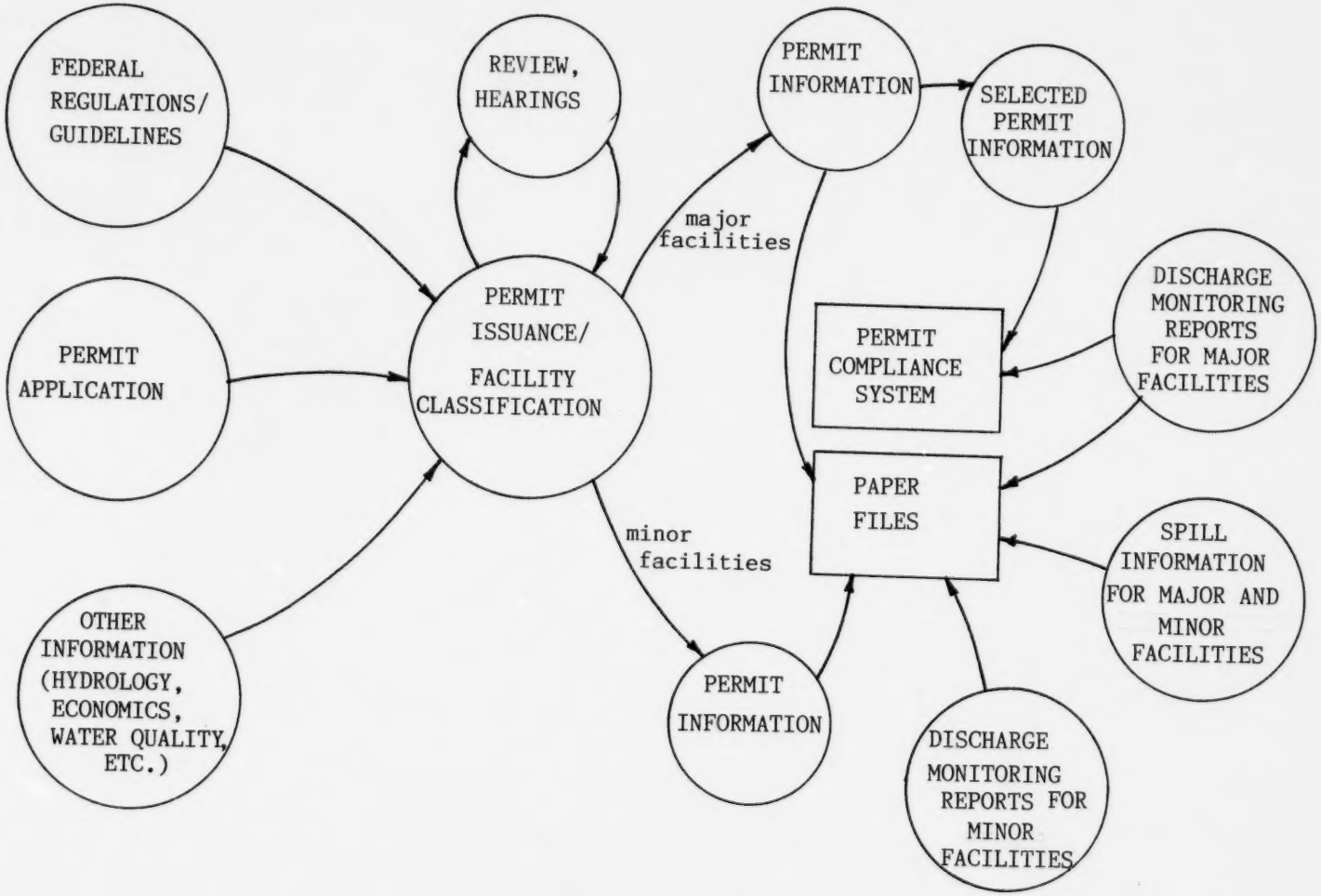


TABLE IV-3

POLLUTANT CONCENTRATIONS (1981) DISCHARGED BY SELECTED ORGANIC CHEMICAL, PLASTICS AND SYNTHETIC FIBERS PLANTS ON THE MISSISSIPPI RIVER

Parameter Industry ->	Shell	Allied	Vulcan	Monochem	Allemania	Georgia Pacific	Air Products	Exxon	Occidental	Allied
River Mile ->	125.5	187.2	183.0	185.0	205.5	205.5	200.5	233.0	222.5	235.5
Flow in MGD ->	3.58	0.76	0.94	1.64	0.60	0.50	0.17	6.74	0.21	1.72
Pollutants (in µg/l)										
Benzene	2	10	3	44	110	10	0.6	7	0	0
Carbon Tetrachloride	0	10	170	1	2	10	2	7	0	0
Chloroethane	0	10	1128	1	2	10	2	2	0	0
Chloroform	10	11	2676	5	2	10	2	7	0	0
Dichlorobromomethane	0	10	3	1	2	10	2	7	0	0
1,1 - Dichloroethane	0	10	600	1	2	10	2	7	0	0
1,2 - Dichloroethane	170	10	11770	1	2	34	2	7	0	0
1,1 - Dichloroethylene	2	10	26	1	2	10	2	2	0	0
Ethyl Benzene	10	10	3	1	2	10	5	7	10	10
Methyl Bromide	0	10	3	1	2	10	2	2	0	0
Methyl Chloride	0	10	2380	1	2	10	1500	2	0	0
Methylene Chloride	0	26	301	3	7	10	2	7	0	0
Toluene	10	10	3	2	65	10	2	7	0	0
1,1,1 - Tri Chloroethane	20	10	86	1	2	10	2	7	0	0
1,1,2 - Tri Chloroethane	10	10	378	1	2	10	2	2	0	0
Trichloroethylene	0	10	4	1	2	10	2	4	0	0
2 - Chlorophenol	0	50	3	1	2	52	2	2	0	0

TABLE IV-3 (Cont.)

POLLUTANT CONCENTRATIONS (1981) DISCHARGED BY SELECTED ORGANIC CHEMICAL, PLASTICS AND SYNTHETIC FIBERS PLANTS ON THE MISSISSIPPI RIVER

Parameter	Industry ->	Shell	Allied	Vulcan	Monochem	Allemania	Georgia Pacific	Air Products	Exxon	Occidental	Allied
	River Mile ->	125.5	187.2	183.0	185.0	205.5	205.5	200.5	233.0	225.5	235.5
	Flow in MGD ->	3.58	0.76	0.94	1.64	0.60	0.50	0.17	6.74	0.21	1.72
Pollutants (in µg/l)											
2,4 - Dichlorophenol		0	50	3	1	2	33	2	6	0	0
2 - Nitrophenol		0	50	3	1	2	10	2	15	0	0
4 - Nitrophenol		0	50	3	1	2	10	2	2	0	0
Pentachlorophenol		0	50	3	1	2	10	2	2	0	0
2,4,6 - Trichlorophenol		0	50	3	1	2	10	2	5	0	0
Acenapthene		0	10	3	1	2	10	2	6	0	0
Acenapthylene		0	1	3	1	6	10	2	7	0	0
Bis (2-Ethyl hexyl) Phthalate		10	47	3	4	11	10	2	10	10	10
1,2 - Dichloro Benzene		0	10	3	1	2	10	2	2	0	0
Diethyl Phthalate		2	6	3	25	0.4	10	1813	1	0	0
Dimethyl Phthalate		0	10	3	1	2	10	1649	4	0	0
Di-N-Butyl Phthalate		10	4	3	1	2	10	3566	4	0	0
Fluorene		0	10	3	1	2	10	2	6	0	0
Isophorene		0	2	3	1	2	10	2	2	0	0
Phenanthrene		0	0	3	1	2	10	2	4	0	0
1,2,4 - Trichloro Benzene		0	10	3	1	2	10	2	2	0	0
Acrolein		0	0	0	0	0	0	0	0	10	10
Vinyl Chloride		0	0	0	0	0	0	0	0	10	10
2,4 - Dimethylphenol		2	50	3	1	2	10	2	8	0	0
2,4 - Dinitrophenol		0	500	3	1	2	10	2	5	0	0

TABLE IV-4

MAJOR DISCHARGERS TO THE LOWER MISSISSIPPI RIVER

NPDES No.	Facility	SIC Code	SIC Description	Parish	River Mile
LA0000060	Avondale Shipyards, New Orleans	3731	Ship building and repairing	Orleans	108.0
LA0000091	Union Carbide, Hahnville	2869	Industrial organic chemicals	St. Charles	128.0
LA0000281	Borden Chemical, Geismar	2869	Industrial organic chemicals	Ascension	185.0
LA0000329	Allied Chemical Corp., Baton Rouge	2819	Industrial inorganic chem.	E. Baton Rouge	231.7
LA0000418	CF Industries, Donaldsonville	2873	Nitrogenous fertilizers	Ascension	174.0
LA0000752	Uniroyal Geismar	2022	Synthetic rubber	Ascension	
LA0000833	American Hoechst Corp.	2865	Cyclic crudes & intermediate	Orleans	235.5
LA0000841	Exxon Corp.	2821	Plastic materials & resins	E. Baton Rouge	244.5
LA0000876	Kaiser Alum. & Chem. Corp.	3334	Primary aluminum	St. Bernard	
LA0000892	Rubicon Chem. Inc., Clark	2869	Industrial organic chem.	Ascension	185.0
LA0000914	Copolymar Rubber & Chem., E. Baton Rouge	2822	Synthetic rubber	E. Baton Rouge	
LA0000922	Copolymar Rubber & Chem., Baton Rouge	2822	Synthetic rubber	E. Baton Rouge	222.8
LA0001376	Celotex Corp., Marrero	2661	Building paper & board mills	Jefferson	
LA0002771	E. I. DuPont, Burnside	2819	Industrial inorganic chem.	Ascension	173.8
LA0002909	Kaiser Raw Material Div.	2819	Industrial inorganic chem.	E. Baton Route	
LA0002933	Vulcan Materials Co., Geismar	2869	Industrial organic chemicals	Ascension	183.0
LA0002950	Basf Wyandotte Corp., Geismar	2869	Industrial organic chemicals	Ascension	184.0
LA0003042	Cajun Elec. Co., Big Cajun	4911	Electric services	Pointe Coupee	
LA0003093	Louisiana Power & Light	4911	Electric services	Jefferson	
LA0003115	Gulf Oil, Belle Chasse-Alliance	2911	Petroleum refining	Plaquemines	
LA0003191	Louisiana Power & Light	4911	Electric services	St. Charles	133.7
LA0003301	Dow Chemical Co., Plaquemine	2869	Industrial organic chemicals	Iberville	210.0
LA0003441	Melamie Chemical Co., Donaldsonville	2869	Industrial organic chemicals	Ascension	173.6
LA0003468	Crown Zellerbach, St. Francisville	2611	Pulp mills	West Feliciana	261.0
LA0003522	Shell Oil Co., Norco	2911	Petroleum refining	St. Charles	125.9
LA0003638	Beker Industries Corp.	2874	Phosphatic fertilizers	St. Charles	124.5
LA0003646	Murphy Oil Corp., Meraux	2911	Petroleum refining	St. Bernard	
LA0003751	Cos-Mar Plant	2865	Cyclic crudes & intermediate	Iberville	188.2
LA0003867	Warren Petroleum Co.	1321	Natural gas liquids	Plaquemines	
LA0003905	Uniroyal Inc., Baton Rouge	2821	Plastic materials & resins	E. Baton Rouge	235.5
LA0004057	Grant Chemical, Baton Rouge	2869	Industrial organic chemicals	Baton Rouge	
LA0004090	Ethyl Corp., Baton Rouge	2819	Industrial organic chemicals	E. Baton Rouge	233.6
LA0004260	Tenneco, Chalmette	2911	Petroleum refining	St. Bernard	
LA0004308	New Orleans Public Service, Mar.	4911	Electric services	Orleans	

TABLE IV-4 (Cont.)

MAJOR DISCHARGERS TO THE LOWER MISSISSIPPI RIVER

NPDES No.	Facility	SIC Code	SIC Description	Parish	River Mile
LA0004316	New Orleans Public Service, Pat.	4911	Electric services	Orleans	
LA0004324	New Orleans Public Service, Mic.	4911	Electric services	Orleans	
LA0004367	American Cyanimid, Westwego	2869	Industrial organic chemicals	Jefferson	114.5
LA0004464	Schuykill Metals, E. Baton Rouge	3332	Primary lead	E. Baton Rouge	
LA0004847	Freeport Chemical	2874	Phosphatic fertilizers	St. James	160.0
LA0005223	Stauffer Chemical	2819	Industrial inorganic chem.	E. Baton Rouge	234.0
LA0005231	Stauffer Ind. Chem. Div.	2812	Alkalies & chlorine	Iberville	198.8
LA0005258	Georgia Pacific, Zachary	2611	Pulp mills	E. Baton Rouge	255.0
LA0005266	Monsanto Co., Luling	2869	Industrial organic chemicals	St. Charles	120.0
LA0005291	Witco Chem. Co., Gretna	2869	Industrial organic chemicals	Jefferson	
LA0005355	Exxon Chem. Co.	2821	Plastic materials & resins	E. Baton Rouge	232.2
LA0005398	Gulf States Utilities	4911	Electric services	E. Baton Rouge	232.5
LA0005401	Exxon Chemical Americas	2869	Industrial organic chemicals	E. Baton Rouge	233.0
LA0005479	Allied Fibers & Plastics Co.	2821	Plastic materials & resins	E. Baton Rouge	235.5
LA0005487	Ciba Geigy, St. Gabriel	2879	Agricultural chemicals	Iberville	198.8
LA0005584	Exxon-Baton Rouge Refinery	2911	Petroleum refining	E. Baton Rouge	231.9
LA0005606	Ormet Corporation	2819		Ascension	170.1
LA0005738	Chevron Chemical Co., Belle Chas.	2869	Industrial organic chemicals	Plaquemines	
LA0005754	Shell Chem., Geismar	2869	Industrial organic chemicals	Ascension	184.3
LA0005762	Shell Chem., Norco	2869	Industrial organic chemicals	St. Charles	125.3
LA0005851	Gulf States Utilities	4911	Electric services	Iberville	201.0
LA0005924	E. I. DuPont de Nemours Co.	2822	Synthetic rubber	St. Charles	135.8
LA0005959	Triad Chem., Donaldsonville	2873	Nitrogenous fertilizers	Ascension	173.4
LA0005983	Occidental Chem., Hooker Div.	2812	Alkalies & chlorine	St. Charles	128.8
LA0005991	Kaiser Alum. Chem. Corp.	2819	Industrial inorganic chem.	St. James	145.2
LA0006009	Allemania Chem. Co.	2869	Industrial organic chemicals	Iberville	205.0
LA0006041	Texaco, Inc., Convent	2911	Petroleum refining	St. James	167.8
LA0006149	Formosa Plastics Corp.	2869	Industrial organic chemicals	E. Baton Rouge	233.6
LA0006165	B. F. Goodrich Co.	2821	Plastic materials & resins	Iberville	210.0
LA0006181	Allied Chemical Corp., Geismar	2874	Phosphatic fertilizers	Ascension	187.2
LA0006220	Monochem Petroleum, Geismar	2869	Industrial organic chemicals	Ascension	185.0
LA0007129	Georgia Pacific Corp., Plaquemines	2869	Industrial organic chemicals	Iberville	205.5
LA0007374	Louisiana Power & Light	4911	Electric services	St. Charles	
LA0007439	Louisiana Power & Light	4911	Electric services	St. Charles	129.3
LA0029769	Agrico Chemical Co.	2873	Nitrogenous fertilizers	Ascension	166.6

TABLE IV-4 (Cont.)

MAJOR DISCHARGERS TO THE LOWER MISSISSIPPI RIVER

NPDES No.	Facility	SIC Code	SIC Description	Parish	River Mile
LA0029963	Gulf Oil Chemical	2865	Cyclic crudes & intermediate	St. James	166.5
LA0038245	Rollins Environmental Services	2869	Industrial organic chemicals	E. Baton Rouge	235.3
LA0038890	Nalco Chemical Co.	2899	Chemical preparations	St. John the Baptist	
LA0039390	Placid Refining Co., Port Allen	2911	Petroleum refining	W. Baton Rouge	232.4
LA0041718	Kaiser Industries Chem. Div.	2819	Industrial inorganic chem.	E. Baton Rouge	233.6
LA0042731	Gulf States Utilities	4111	Electric services	W. Feliciana	
LA0045233	Amax Nickel Refining Co.	3339	Primary non-ferrous metals	Plaquemines	
LA0045683	Marathon Petroleum	2911	Petroleum refining	St. John the Baptist	140.1
LA0045942	Petro United Terminals	4226	Special warehousing & storage	Iberville	
LA0046361	Air Products & Chemicals	2869	Industrial organic chemicals	Iberville	200.5
LA0046787	Lajet, Inc.	2911	Petroleum refining	St. James	
LA0050962	Shell Chemical Co.	2821	Plastics materials & resins	St. Charles	
LA0051993	Clark Acquisition Inc.	2911	Petroleum refining	St. John the Baptist	261.0
LA0052051	Good Hope Refineries, Inc.	2911	Petroleum refining	St. Charles	
LA0052353	Sun Terminals, Inc. of La.	2911	Petroleum refining	Iberville	
LA0054216	International Processors	2911	Petroleum refining	St. Charles	
LA0055794	Occidental Chemical Co.	2821	Plastics materials & resins	W. Baton Rouge	222.5
LA0056171	Convent Chemical Corp.	2812	Alkalies & chlorine	St. James	
LA0059846	B. F. Goodrich Chemical Div.	2869	Industrial organic chemicals	St. James	161.3
LA0059862	Petroleum Fuel & Terminal Co.	2911	Petroleum refining	Iberville	
LA0059901	Freeport Uranium Recovery	1094	Uranium-radium-vanadium ores	St. James	
LA0060151	JT Corporation, Burnside	9999	Nonclassifiable establishment	Ascension	
LA0063878	CRI Metals, Inc., Luling	3341	Secondary non-ferrous metals	St. Charles	
LA0064327	Ashland Dev. Inc.	2869	Industrial organic chemicals	Iberville	

FIGURE IV - 8

EXAMPLE PCS PERMIT SUMMARY REPORT

P.C.S. CONDENSED LIMITATIONS SUMMARY REPORT — PAGE 200
LIMITATION SUMMARIES — 01/19/84

NPDES-LA0006181 ALLIED CHEMICAL CORP-GEISMAR
003-A - PHOSPHORIC ACID MANUFACTURE EF ACTIVE - (CONTINUED)

FINAL LIMITS START--END	CONT.	QUANTITY AVERAGE	QUANTITY MAXIMUM	UNIT	MINIMUM	CONCENTRATION AVERAGE	CONCENTRATION MAXIMUM	UNIT	FREQ OF ANALYSIS	SAMPLE TYPE	STAT BASE
781217-810331	*PARAMETER 00530-1-0										
	SOLIDS, TOTAL					50	150	MG/L	01/07	24	14
	SUSPENDED										
	EFF GROSS VALUE										
	*PARAMETER 00665-1-0										
	PHOSPHORUS, TOTAL					35	105	MG/L	03/07	24	14
	(AS P)										
	EFF GROSS VALUE										
	*PARAMETER 00951-1-0										
	FLUORIDE, TOTAL					25	75	MG/L	03/07	24	14
	(AS F)										
	EFF GROSS VALUE										
	*PARAMETER 50050-1-0										
	FLOW, IN CONDUIT OR			MGD					99/99		
	THRU TREATMENT PLANT										
	EFF GROSS VALUE										

COMMENT 1 SEG 1,2,3 SEE PART III OF PERMIT FOR OTHER REQS, MONITOR UPSTREAM OF FLOW MEASURING DEVICE.
COMMENT 2 SEG 4,5,6 THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM EXCEPT IN TRACE AMOUNTS.
COMMENT 3 SEG 7,8,9

004-A - HF & ALF3 MANUFACTURE EFFLUENT ACTIVE -
SEASONAL MASK YYYYYYYYYYYY WASTE TYPE 20 REVIEW- START 781201 REPORTING FREQ-TOTAL M001 060 SUBMISSION-FREQ EPA 790128-M003 SUBMISSION - FREQ STATE 790128-M003 #NDML

FINAL LIMITS START--END	*PARAMETER 00011-1-0	QUANTITY AVERAGE	QUANTITY MAXIMUM	UNIT	MINIMUM	CONCENTRATION AVERAGE	CONCENTRATION MAXIMUM	UNIT	FREQ OF ANALYSIS	SAMPLE TYPE	STAT BASE
781217-810331	TEMPERATURE, WATER DEG. FAHRENHEIT				DELMON			DEG.F	99/99		
	EFF GROSS VALUE										
	*PARAMETER 00400-1-0										
	PH				6.0		9.0	SU	99/99		15
	EFF GROSS VALUE										
	*PARAMETER 00530-1-0										
	SOLIDS, TOTAL							MG/L	01/07	24	
	SUSPENDED										
	EFF GROSS VALUE										
	*PARAMETER 00951-1-0										
	FLUORIDE, TOTAL					30	90	MG/L	03/07	24	14
	(AS F)										
	EFF GROSS VALUE										
	*PARAMETER 50050-1-0										
	FLOW, IN CONDUIT OR			MGD					99/99		
	THRU TREATMENT PLANT										
	EFF GROSS VALUE										

COMMENT 1 SEG 1,2,3 SEE PART III OF PERMIT FOR OTHER REQS, MONITOR UPSTREAM OF FLOW MEASURING DEVICE.
COMMENT 2 SEG 4,5,6 THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM EXCEPT IN TRACE AMOUNTS.
COMMENT 3 SEG 7,8,9

FIGURE IV - 9

EXAMPLE PCS PERMIT VIOLATIONS REPORT

84/01/10

P. C. S. QUICK LOOK REPORT
LOWER MISS CARD R DATA FOR JULY-83

PAGE 014

NPDES/RCRA NUMBER	FAC NAME (8 CHAR)	VIO NUMBER	DISCH DESIGN	VIO LIM	RPT VIO	VIO DATE	VIO PARAM	MEASURED QUAN AVG	MEASURED QUAN MAX	MEASURED CONC MIN	MEASURED CONC AVG	MEASURED CONC MAX	VIO EVENT	RD04
LA0000922	COPOLYME	001	A	F		830731	00011				90	102	E00	BIUS
		001	A	F		830731	00310	83	123	11	16	25	E00	
		001	A	F		830731	00340	201	495	8	33	54	E00	
		001	A	F		830731	00400			6.5		7.9	E00	
		001	A	F		830731	00530	29	59	1	7	12	E00	
		001	A	F		830731	00556	8	83				E00	
		001	A	F		830731	00610	49	101	6	8.7	11	E00	
		001	A	F		830731	01087	3.3	3.6	0.35	0.71	1.05	E00	
		001	A	F		830731	01147	< 0.006	< 0.006		< 0.002	< 0.002	E00	
		001	A	F		830731	34010	< 0.03	< 0.03		< 0.01	< 0.01	E00	
		002	A	F		830731	50050	684000	1100000				E00	
		002	A	F		830731	00340					29	E00	
		002	A	F		830731	00400			4.8		7.3	E00	
		002	A	F		830731	00556					5.0	E00	
		002	A	F		830731	50050	0.388	0.461				E00	
		01A	A	F		830731	00310				2	5	E00	
		01A	A	F		830731	00530				7.5	9	E00	
		002	A	F		830731	50050				0.388	0.461	E01	
		01A	A	F		830731	50050				0.014	0.023	E01	

SUB-TOTAL NUMBER OF QUICK LOOK LINES IS 19

No information on minor permits is stored in PCS. This information, along with monitoring results are stored in hard copy files.

Another category of discharge data is information related to non-routine "spills" or "bypasses" discharged to the river. Industries are required to report such events to the State and to Region VI, USEPA. These reports include the details of the spill (what, when, how much, where) and a textual description of the spill and its cause. This information is not entered into PCS, but is stored in hard copy files.

Other sources of discharger data include the USEPA Industrial Facilities (IFD) file and Louisiana Department of Natural Resources files. However, this information is less complete and generally redundant to the information available in PCS or in the USEPA Region VI files.

A separate class of pollutants entering the Mississippi River are non-point sources of pollution. Included within this category are agricultural runoff, urban storm runoff, diffuse vessel discharges, etc. Approximate estimations of the level of non-point sources were made as part of the Louisiana Water Quality Management Plan (Reference IV-3). Due to the diffuse and non-continuous nature of these types of sources, more refined estimates are difficult and costly to acquire.

COMPUTER DATA BASES

USEPA maintains several computer data bases containing information potentially useful in the modeling of the Lower Mississippi River. Additionally, several data files have been created during the conduct of this study, containing water quality and streamflow information on the Lower Mississippi River. These computer data bases are described in this section.

USEPA Data Bases

The following data bases maintained by the USEPA contain information that may be useful in either the parameterization or validation of mathematical models:

- Reach File
- Industrial Facilities Discharge File
- Pollutant Matrix File
- STORET
- Permit Compliance System (PCS)

A brief description of these data bases follows.

The Reach File System contains information on approximately 68,000 river segments (called reaches) in the United States. The file is organized by hydrologic areas, and the hydrologic connectivity between reaches (topology) is stored in the file. This connectivity allows the system to trace flow between reaches and thus to perform "routing" through the stream network. Other information maintained within the Reach File System are annual average, low and average monthly streamflow values, travel time estimates, stream lengths, and hydrologic stream orders. A series of computer programs, entitled,

"The Routing and Graphical Display System (RGDS)", perform pollutant routing and a wide range of plot capabilities for displaying information within or generated by the Reach File.

The Industrial Facilities Discharge (IFD) file contains information on approximately 45,000 industrial and municipal discharges in the United States. Information in the IFD file pertains to both facilities and the individual pipe discharges at the facilities. The types of information available from the IFD files include:

- location (reach number and in some cases the reach location in terms of miles above the downstream end of the reach);
- type of facility (Standard Industrial Category (SIC) and/or the industrial category as defined by the Effluent Guidelines group at EPA); and
- average or permitted flow rate.

Information in the IFD file may be accessed by individual pipes or facilities, or by reach or by higher level hydrologic areas (catalog units).

The IFD file does not contain information on the pollutant constituents in the discharges of the facilities. However, a mechanism for estimating such constituents is provided by the Pollutant Matrix File. The Pollutant Matrix File provides a representative pollutant concentration for selected pollutants by industrial category and general treatment level. The 27 industrial categories addressed by the matrix correspond to those stored in the IFD file, and include a category for publically owned treatment works (POTW's). Four general general treatment levels included in the Pollutant Matrix File are:

- 1972 - General level of treatment prior to PL 92-500
- Current - General level of treatment currently in use
- BPT - Best Practical Treatment
- BAT - Best Available Treatment

The Pollutant Matrix File currently contains pollutant concentrations on 10 heavy metals and phenol. However, efforts are currently under study at USEPA to expand this matrix to include a wider range of constituents.

The STORET (STOrage and RETrieval) system is USEPA's management information system for information on water quality, streamflow, municipal waste facilities, fish kills, and other related data (Reference IV-13). Water quality data may be retrieved from STORET in raw form or may be statistically analyzed or graphically displayed.

The Permit Compliance System (PCS) is a data base and associated programs maintained by USEPA to track compliance with NPDES (National Pollutant Discharge Elimination System) permits. PCS contains baseline information on major dischargers, such as facility and owner information and permit limitations. Additionally, sampling data supplied by permittees on a routine basis as part of their Discharge Monitoring Reports (DMR) are stored in the system. All information contained in the PCS is public information.

Project Data Base

As part of the present study, a computerized data base of currently available information on organics in the Lower Mississippi River was assembled. The sources of these data, sampling stations, period of sampling, and pollutants sampled have been described previously in this chapter, and are summarized in Table IV-5. The sampling data have been organized in a common format with the following information stored for each observation. Further details on the codes and formats utilized in these files are provided in Appendix B.

- Source code (source of data)
- Observation number (unique number for each sample)
- Station number (code for each sampling location)
- Substation number (lateral location of sample within the river)
- Year
- Day
- Constituent number (unique number for each constituent)
- River mile
- "Less than" code (code indicating if sample concentration has been given as less than given value)
- Value (concentration for pollutants, flow rate for streamflow)

The constituent numbering system utilized in this data base is based upon a numbering system utilized in the analysis of the extensive Jefferson Parish data base (References IV-1, IV-14). Through correlation tables, this numbering system may be related to other indexing systems, such as STORET, Chemical Abstracts Service (CAS) or priority pollutant numbers.

SUMMARY

Data have been collected and sources of data have been identified relative to the water quality, streamflow, flow dynamics and discharges to the Lower Mississippi River. A significant amount of data has been collected in the water quality, stream flow, and flow dynamics areas, and entered into a computer data base. Sources of information on the discharge of pollutants with emphasis on organics have been identified. However, the extent of data in this area is limited relative to the other data categories.

REFERENCES

IV-1. Koffskey, W.E., and N. V. Brodtmann, "Organic Contaminant Removal in Lower Mississippi River Drinking Water by Granular Activated Carbon Adsorption," USEPA, MERL, Cincinnati, OH, 1983.

IV-2. USGS, "Water Resources Data Louisiana - Water Year 1982," Baton Rouge, LA., 1982.

TABLE IV - 5

SUMMARY OF DATA STORED IN COMPUTERIZED PROJECT DATA BASE

Data Source	No. of Sampling Stations	Period of Sampling	No. of Parameters	Total No. of Observations*
Jefferson Parish	1	Feb.1977 - Oct.1979	153	34455
Jefferson Parish	1	Oct.1979 - Nov.1983	14†	1830
New Orleans	1	Sept.1980 - Dec.1983	6†	5190
Louisiana Dept. of Natural Resources	12	Dec.1982 - Sept.1983	29	11339
USGS	1	1977 - Sept.1981	Suspended solids	1734
U. S. Army Corps of Engineers	1	1977 - 1982	Streamflow	2191

* An observation corresponds to a sample analyzed for a single pollutant.

† Additional routine sampling is performed but was not inserted into the project data base.

IV-3. Stanley Consultants, "Mississippi River Basin Water Quality Management Plan - Phase II," Louisiana Depart. of Natural Resources, Baton Rouge, LA., 1980.

IV-4. Personal Communication, Quin Humphreys, U. S. Army Corps of Engineers, New Orleans, 1984.

IV-5. Personal Communication, George Cry, National Weather Service, River Forecast Center, Slidell, MS., 1984.

IV-6. Stewart, M. R., "Time of Travel of Solutes in Mississippi River from Baton Rouge to New Orleans, LA.," U. S. Geological Survey, Hydol. Inv. Atlas HA-260, 1967.

IV-7. Everett, D. E., "Hydrologic and Quality Characteristics of the Lower Mississippi River," Louisiana Dept. Public Works Tech. Rep. 5, 1971.

IV-8. Martens, L. A. et al., "Time of Travel of Solutes in Mississippi River from Baton Rouge to Pointe a la Hache, Louisiana," Louisiana Dept. of Public Works, Baton Rouge, LA., 1974.

IV-9. Calandro, A. J., "Time of Travel of Solutes in Mississippi River from the Arkansas-Louisiana state line to Plaquemine, LA., "Louisiana Dept. of Public Works, Baton Rouge, LA., 1976.

IV-10. Personal Communication, Peter Romanowsky, Water Pollution Control Division, Louisiana Department of Natural Resources, 1984.

IV-11. Burmaster, D. and M. Huguenin, Draft Memorandum to P. Caulkins, USEPA, Office of Policy, Planning & Evaluation, on Mississippi River Feasi_ bility Study, 1984.

IV-12. Personal Communication, Dr. John Dehn, USEPA Region VI, Dallas, 1984.

IV-13. USEPA, "STORET User Handbook," USEPA Office of Water and Hazardous Materials, Washington, D. C., 1977.

IV-14. Grayman, W. M., J. E. Sarsenski, P. J. Wehrman, P. D. Koch, "Conceptual Development of a Toxic Screening Model," USEPA, MERL, Cincinnati, OH., 1984.

IV-15. Louisiana Department of Health and Human Resources, "Waterworks Warning Network Plan - Lower Mississippi River", Office of Health Services and Environmental Quality, Baton Rouge, LA, 1983.

Chapter V

WATER QUALITY OF THE LOWER MISSISSIPPI RIVER

INTRODUCTION

The water quality data base described in the previous chapter in conjunction with the results of previous studies of the Lower Mississippi River may be used to characterize the water quality of the river. Such a characterization is useful in identifying the temporal and spatial trends in the water quality of the river, as a source of information useful in the design or modification of monitoring programs, and in the development/calibration of a mathematical model of the water quality behavior of the river.

In this chapter, the results of several recent studies of the water quality of the Lower Mississippi River are summarized. Additionally, statistical analyses of the data performed as part of the present study are presented along with recommendations concerning improvements in the ongoing monitoring programs.

PREVIOUS STUDIES

Though no in depth study of the water quality of the Lower Mississippi River has been performed previously, several studies aimed at specific aspects of the problem have been performed. The results of these studies are useful in developing an overall view of the water quality characteristics of the Lower Mississippi River.

In this section, the results of several representative studies of the Lower Mississippi River are summarized. These studies do not form the full spectrum of all previous work but were selected because of their availability and their direct relationship to the present study.

EPA Region VI Studies

The Environmental Analysis Section of EPA Region VI has conducted two in-house studies aimed at characterizing and summarizing the level and trends of organic compounds in the Lower Mississippi River (Reference V-1, V-2). Both studies utilized data collected at Jefferson Parish, Louisiana for the EPA Drinking Water Research Division during the period from 1977 to 1979 (Reference V-3).

In the first study (Reference V-1), monthly means were computed for five organic constituents sampled at Jefferson Parish and phenol measurements made by USGS and a linear trend model of the following form was fit to the data:

$$Y = b_o + b_1T + b_2 + b_3T^3 + e$$

where Y is the monthly concentration, T is the month number beginning with January, 1977 as month 1, b_o, b_1, b_2 and b_3 are fitting coefficients and e is an error term. Utilizing regression analysis, best fit equations were developed for each constituent. It was the conclusion of EPA that "generally conclusive statements regarding trends cannot be made" based on the linear model due to the "large variability exhibited by the data, the existence of data gaps, and the short time frame". More interesting were the bar charts of monthly means and annual means. As illustrated in Figure V-1, the concentrations appeared to display a seasonal cyclical trend. Furthermore plots of annual means, Figure V-2, suggest the possibility of a general trend of decreasing concentrations with time.

In the second study (Reference V-2), a wider range of organic compounds was analyzed. The twenty most prevalent compounds for each of the three years of data studied are presented in Table V-1. In terms of absolute magnitude, 1,2-dichloroethane was identified as the most dominant compound. The 81 organic compounds were aggregated into ten categorical groups, as shown in Table V-2, and further analyses and displays performed. As shown in Table V-3, the halogenated aliphatics and trihalomethanes were the most prevalent groups accounting for 88% of the total concentration over the 3 year period. The relationship between groups is shown graphically in Figure V-3 for the year 1978. Within groups, total concentration was generally dominated by a single compound as shown in Table V-4. For example, in the halogenated aliphatics and trihalomethanes, 1,2-dichloroethane and chloroform respectively accounted for a significant majority of the concentration in each group. The study noted, "a substantial reduction in total organic concentration from 1977 to 1979 due primarily to the large decreases occurring in the first two groups, the halogenated aliphatics and the trihalomethanes". However, it did caution that the "differences are exaggerated somewhat due to the presence of data gaps and because not all groups were analyzed over the entire 3-year period". The study did conclude that, "a decrease in total organic annual mean concentrations is evident", and that the "decrease in yearly maximums though substantial, is not as dramatic as with annual mean".

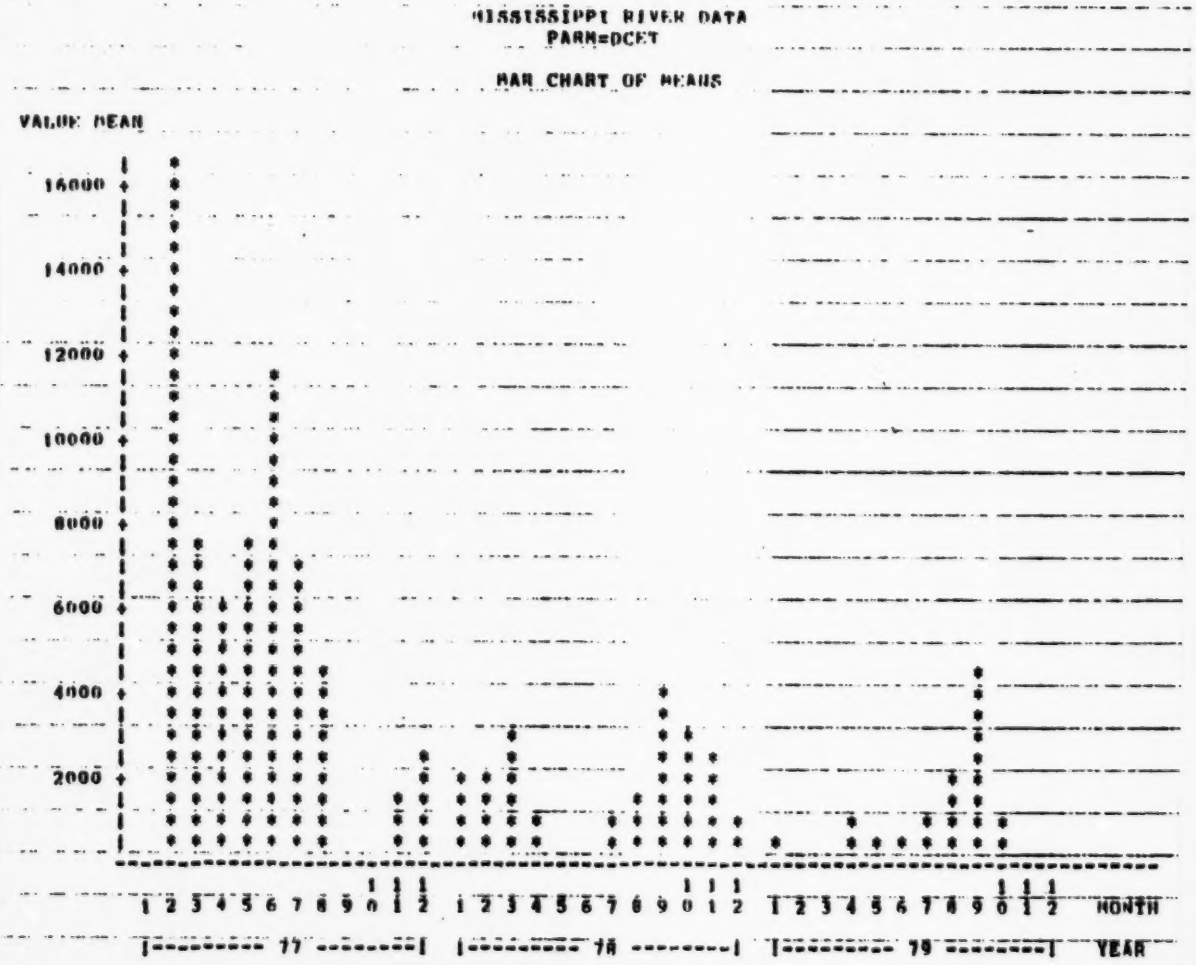
Louisiana Department of Natural Resources Study

Because of concern raised by short term, higher than normal levels of 1,2-dichloroethane observed in the Mississippi River at New Orleans during a period from September 1980 to September 1981, the Department of Natural Resources of Louisiana undertook a study and prepared a report for the Governor on this issue (Reference V-4). This compound was of particular concern because it is a suspected carcinogenic agent and because a large amount of the compound is produced at industries located on the Mississippi River above New Orleans in Louisiana. The report estimates that as of 1981, approximately four billion pounds of 1,2-dichloroethane was produced annually by those industries.

Permitted discharges of the compound were identified as "responsible in part for the normal background in the Mississippi which averaged less than

FIGURE V - 1

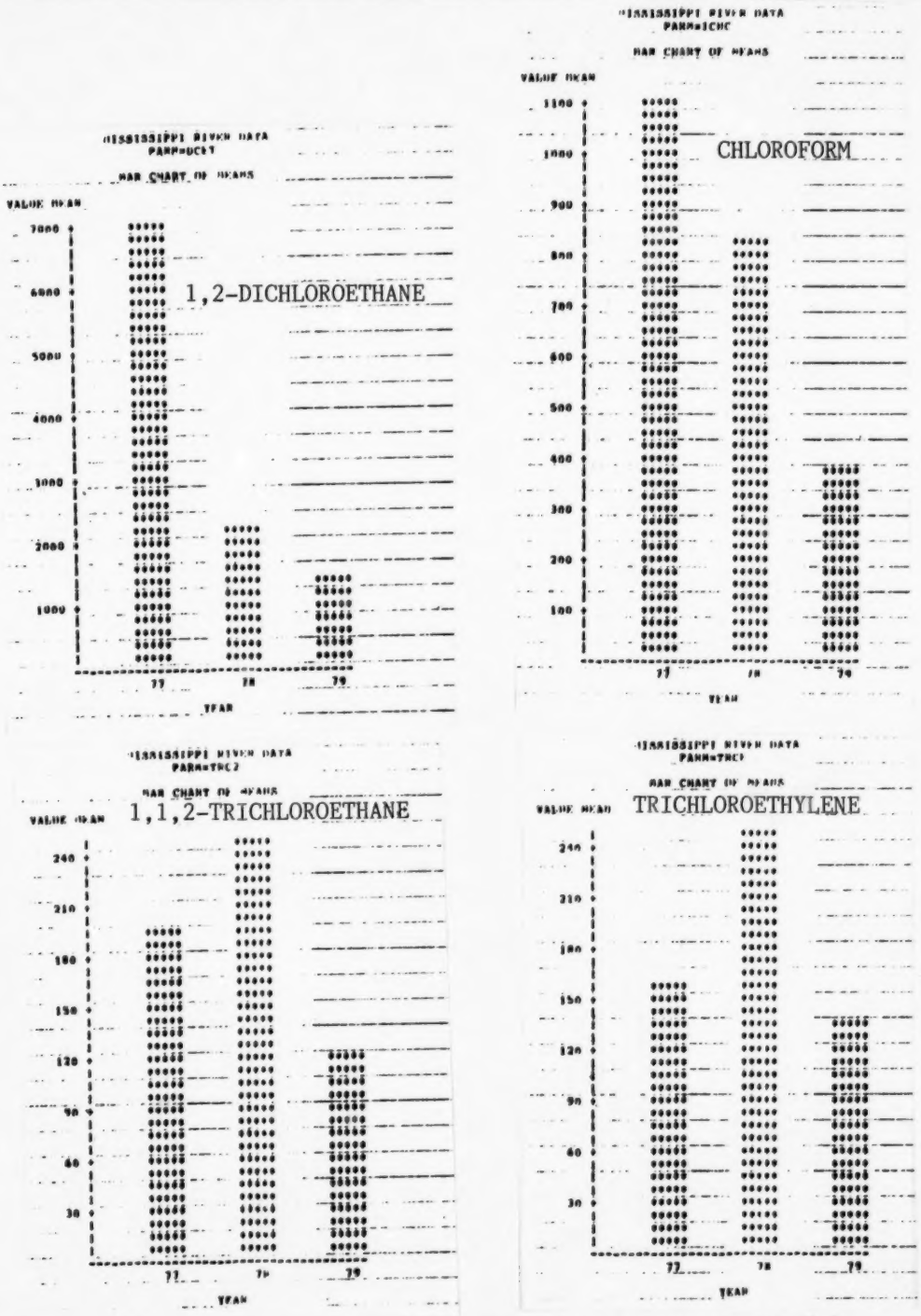
MONTHLY MEAN CONCENTRATIONS OF 1,2-DICHLOROETHANE AT JEFFERSON PARISH, LA.



Source: Figure reproduced directly from Reference V-1

FIGURE V - 2

ANNUAL MEAN CONCENTRATIONS OF SELECTED POLLUTANTS AT JEFFERSON PARISH, LA.



Source: Figure reproduced directly from Reference V-1

TABLE V - 1

Top 20 Compounds with Highest Annual Means
Lower Mississippi River at Jefferson Parish
1977-1979
(concentrations in parts per trillion)

Rank	1977 Compound	1977 Conc.	1978 Compound	1978 Conc.	1979 Compound	1979 Conc.	1977-1979 Compound	1977-1979 Conc.
1	DCET	7079	DCET	2146	DCET	1440	DCET	3585
2	DCME	1979	ICHC	837	ICHC	385	ICHC	800
3	ICHC	1091	BENZ	409	TRCE	137	DCME	629
4	ATRA	755	TRC2	251	TRC2	117	TCME	248
5	TCME	542	TRCE	249	TCME	111	ATRA	233
6	TRC2	193	TCET	128	TBR1	95	BENZ	229
7	TRCE	156	DCME	118	ATRA	61	TRC2	196
8	BENZ	141	ATRA	113	DNBL	55	TRCE	188
9	BNBL	53	TCME	98	DCME	42	TCET	75
10	CLRB	46	DNBL	94	DETL	24	DNBL	73
11	TOLU	42	DETL	72	ACNP	24	IBR1	61
12	BRCM	33	IBR1	66	CLRN	20	DETL	46
13	NITR	28	TOLU	53	NDOD	17	TOLU	46
14	DCBN	28	ACNP	48	NHEP	17	ACNP	35
15	IBR1	27	NITR	39	TCET	17	NITR	28
16	NTET	27	CLRN	35	B2ET	13	CLRN	27
17	DETL	19	B2ET	29	NITR	12	NHEP	21
18	NDOD	13	NHEP	25	NEIC	12	BRCM	19
19	NTRI	12	NOCT	15	CLET	10	B2ET	17
20	NPEN	12	NEIC	13	ISOP	10	CLRB	16

Source: Reference V-2

TABLE V - 2

ORGANIC COMPOUNDS IN THE LOWER MISSISSIPPI RIVER DATA BASE CLASSSIFIED BY GROUP

Group No.	Group Name	Compounds
1	Halogenated Aliphatics	- 1, 2 dichloroethane (DCET) - trichlorethylene (TRCE) - dichloromethane (DCME) - tetrachloromethane (TCME) - bromochloromethane (BRCM) - dichloroethylene (DCE2) - tetrachloroethylene (TCET) - chloroethylene (CLET) - 1,1,2,2 tetrachloroethane (TECE) - 1,1,2 trichloroethane (TRC2)
2	Trihalomethanes	- chloroform (ICHC) - bromodichloromethane (IBR1) - chlorodibromomethane (IBR2) - bromoform (1BR3)
3	Pesticides	- alpha benzene hexachloride (ABHC) - beta benzene hexachloride (BBHC) - gamma benzene hexachloride (GBHC) - hexachlorobenzene (HXCL) - heptachlor (HEPT) - alpha chlordene (ACHL) - beta chlordene (BCHL) - gamma chlordene (GCHL) - aldrin (ALDR) - heptachlor epoxide (HEPC) - alpha chlordane (ACH2) - gamma chlordane (GCH2) - ortho para DDE (OPDDE) - endosulfan-1 (ENDS) - endosulfan-2 (END2) - dieldrin (DIEL) - ortho para DDD (OPDDD) - para para DDD (PPDDD) - meta para DDD (MPDDD) - endrin (ENDR) - ortho para DDT (OPDDT) - para para DDT (PPDDT) - photodieldrin (PHOT) - methoxychlor (METH) - mirex (MIRE) - isophorone (ISOP) - atrazine (ATRA) - oxy-chlordan (OXCH)
4	Alkanes	- n-decane (NDEC) - n-undecane (NUND) - n-dodecane (NDOD) - n-tridecane (NTRI) - n-tetradecane (NTET) - n-pentadecan (PENT) - n-perthane (PERT) - n-hexadecane (NHEX) - n-octadecane (NOCT) - n-nonadecane (NNON) - n-eicosane (NEIC)
5	Polynuclear Aromatics	- acenaphthene (ACEN) - phenanthrene (PHEA) - anthracene (ANTR) - fluoranthene (FLOR) - pyrene (PYRE) - naphthalene (NPTH) - methyl naphthalene (MET3) - acetonaphthone (ACNP)
6	Phthalates	- bis (2-ethylhexyl) (B2ET) - dipropyl (DPRO) - dimethyl tetrachlorotere (DCPA) - di-isobutyl (DIPL) - dimenthyl (DMEL) - di-n-butyl (DNBL) - di-ethyl (DETL)
7	Aromatics	
	* subgroup 1	- benzene (BENZ) - toluene (TOLU)
	* subgroup 2	- nitrobenzene (NITR) - biphenyl (BIPH) - triphenyl methane (TRPH)
	* subgroup 3	- benzonitrile (BNZN) - benzyl cyanide (BNZY) - nitrotoluene (NTOL) - ethyl benzene (ETBN)
8	Halogenated Aromatics	- chlorobenzene (CLRB) - metadichlorobenzene (DCBN) - chloronitrobenzene (CLRN) - pentachloronitro benzene (PCLR)

Source: Reference V-2

TABLE V - 3

Contribution of Organic Groups to Total Organics Concentration
Lower Mississippi River at Jefferson Parish, 1977-1979

° ANNUAL MEANS (Parts per Trillion)

(Percent of total concentration given in parenthesis)

GROUP	1977	1978	1979
Halogenated Aliphatics	9790 (72)	2984 (59)	1770 (67)
Trihalomethanes	2534 (19)	1001 (20)	527 (20)
Pesticides	758[1] (6)	202 (4)	88 (3)
Alkanes	85[2] (<1)	102 (2)	92 (3)
Polynuclear Aromatics	19[3] (<1)	74 (1)	43 (2)
Phthalates	74[4] (<1)	130 (3)	76 (3)
Aromatics			
Subgroup 1	183 (1)	462 (9)	---
Subgroup 2	33 (<1)	41 (<1)	13 (<1)
Subgroup 3	---	2 (<1)	13 (<1)
Halogenated Aromatics	74[5] (<1)	37 (<1)	27 (1)
Total	13,550 ppt	5,035 ppt	2,649 ppt
° Range (Daily)	1,014-46,841	1,248-16,971	694-25,874

[1] Total does not include OXCH and MPDDD

[2] Total does not include PERT, NHEX, NHEP, NOCT, NNON, and NEIC

[3] Total does not include NPTH, MET3, and ACNP

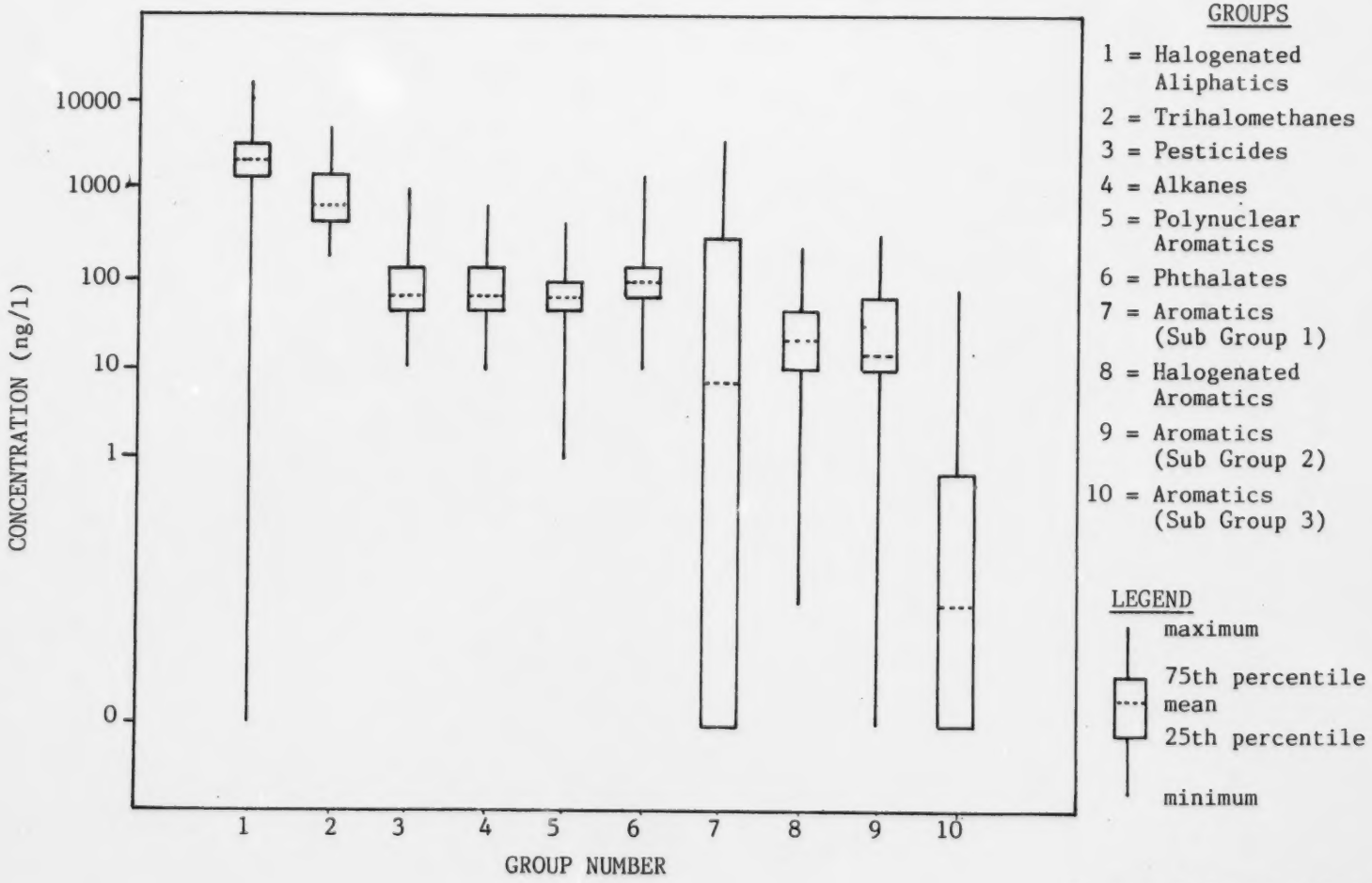
[4] Total does not include DCPA

[5] Total does not include PCLR and CLRN

Source: Reference V-2

FIGURE V - 3

RANGE OF CONCENTRATIONS BY POLLUTANT GROUPS AT JEFFERSON PARISH (1978)



Source: Reference V-2

TABLE V - 4

DOMINANT COMPOUNDS WITHIN ORGANIC GROUPS IN THE LOWER MISSISSIPPI RIVER

	Percent	Cumulative percent within group
Halogenated Aliphatics		
- 1,2 dichloroethane	74	74
- dichloromethane	10	84
Trihalomethanes		
- chloroform	83	83
Pesticides *		
- atrazine	70	70
- isophorone	11	81
Alkanes *		
- n-dodecane	16	16
- n-heptadecane	25	41
- n-eicosane	12	53
- n-octadecane	10	63
Polynuclear Aromatics *		
- naphthalene	15	15
- acenaphthene	59	74
Phthalates *		
- di-n-butyl phthalate	77	77
- bis(2-ethyl hexyl) phthalate	14	91
Aromatics *		
° Subgroup 1		
- benzene	83	83
° Subgroup 2		
- nitrobenzene	91	91
° Subgroup 3		
- nitrotoluene	36	36
- benzonitrile	40	76
Halogenated Aromatics *		
- Chloronitrobenzene	96	96

* Based on two years of data.

Source: Reference V-2

one part per billion". However, as illustrated in Figure V-4, frequent short-term peak values far in excess of the background values were observed. The report notes that, "possible sources of these excessive amounts would be accidental spills caused by equipment failure or operator error and/or deliberate illegal discharges of contaminated materials". Attempts at correlating reports of specific discharges to the observed peaks met with some but relatively minimal success (see Figure V-4).

The study did conclude that, "historical evidence shows a decrease in levels of 1,2-dichloroethane discharges permitted over a period of recent years" which is consistent with the observed results in the previously referenced EPA Region VI study (Reference V-2). Another significant result, partially as a result of this study, was the implementation of a major organics monitoring program by the state. This program has been described in Chapter IV of the present report.

Conceptual Toxic Screening Model Study

In a recent study for the Drinking Water Research Division, EPA, as part of the development of a toxic screening model and its application to the Lower Mississippi River, some analysis of the characteristics of the water quality of the Lower Mississippi River was performed (Reference V-5). This study utilized the data collected for EPA at Jefferson Parish, Louisiana (Reference V-3).

Statistical analysis was performed on selected constituents (primarily organics). A summary of this analysis is presented in Table V-5. Based on this analysis several conclusions and observations were made:

- The variability in the concentration and loading of most contaminants is great leading to the presumption that both streamflow influences pollutant concentrations, and the discharge of the mass of contaminants varies greatly. The frequency distribution for the selected contaminants is presented in Figure V-5.

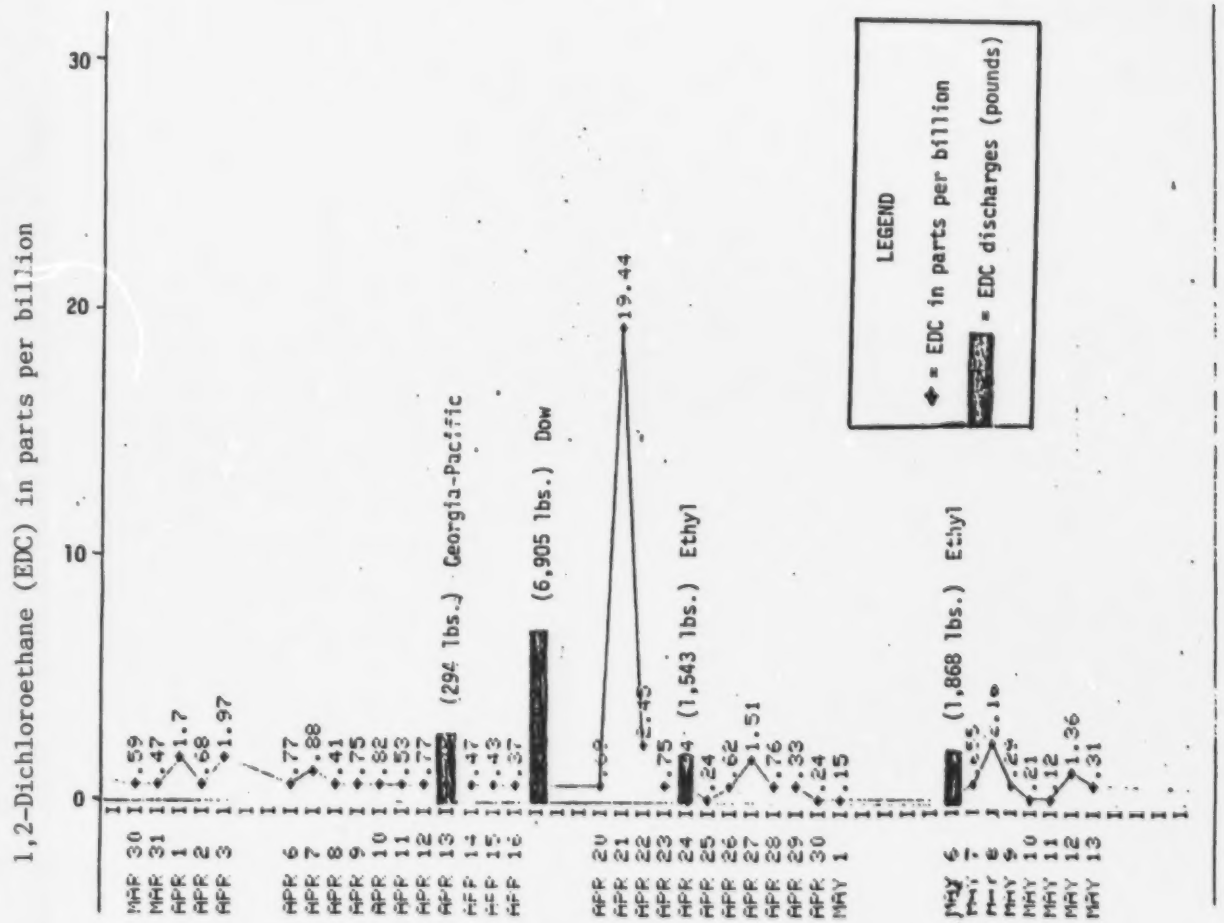
- Based on the lack of correlation between streamflow and contaminant concentration/load for most contaminants, there is very little relationship between flow in the river and the presence of contaminants.

- A few contaminants appeared to be strongly negatively correlated to streamflow (i.e., as streamflow increases, contaminant/concentration decreases). This suggests that the contaminant mass discharged is reasonably constant for these constituents.

- There appears to be a strong positive correlation between streamflow and contaminant concentration for a few contaminants. This is not as easy to interpret but may be caused by increased discharges of contaminants at higher flows including contaminants contained in runoff or groundwater inflow.

FIGURE V - 4

COMPARISON OF SAMPLED 1,2-DICHLOROETHANE AND REPORTED IRREGULAR DISCHARGES



Source: Figure reproduced directly from Reference V-4

TABLE V-5

STATISTICAL CHARACTERISTICS OF SELECTED POLLUTANTS

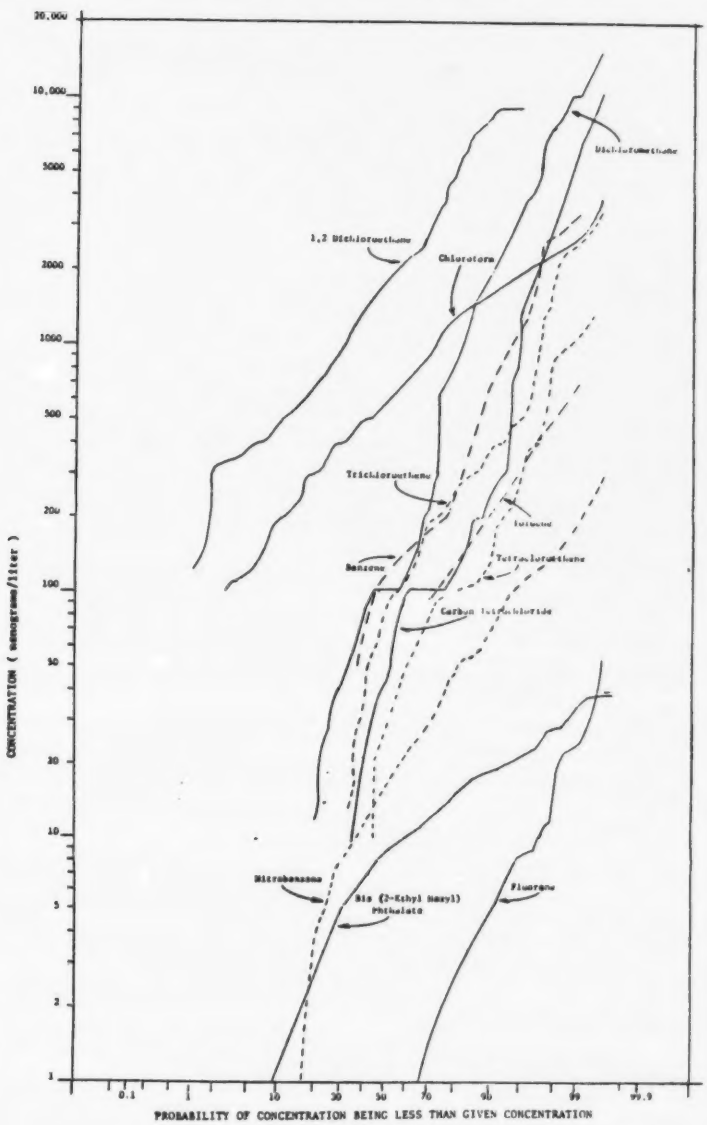
IN THE MISSISSIPPI RIVER AT JEFFERSON PARISH

POLL. NO.	POLLUTANT	NO. OF SAMPLES	CONCENTRATION ng/L (10^{-9} grams/liter)				Load Thousand Pounds/Day	
			AVERAGE	STANDARD DEVIATION	LOWER 10%	UPPER 10%	AVERAGE	STANDARD DEVIATION
47	Dichloromethane	209	712	1824	0	1900	1.34	3.17
7	Chloroform	209	800	633	200	1660	1.80	1.54
43	Carbon Tetrachloride	209	248	1006	0	250	0.50	1.63
23	1,2 Dichloro-ethane	209	3585	4889	480	8600	7.30	8.46
35	Trichloroethene	209	188	396	0	390	0.53	1.47
126	Tetrachloroethene	156	74.6	170	0	140	0.20	0.52
27	Benzene	103	229	526	0	720	0.56	1.25
31	Toluene	103	45.5	100	0	210	0.11	0.29
91	Bis (2-Ethyl Hexyl) Phthalate	306	16.8	97	1.1	18.7	0.05	0.29
104	Fluroene	263	1.72	4.6	0	4.8	0.006	0.018
98	Nibrobenzene	263	28.2	37.7	0	70	0.06	0.17

Source: Reference V-5

FIGURE V - 5

DISTRIBUTION OF SELECTED POLLUTANTS



Source: Figure reproduced directly from Reference V-3

- There appears to be very little correlation between the concentration of contaminants and suspended solids. This is interpreted to mean that sediments do not appear to act as a significant reservoir or transport mechanism for the contaminants (assuming the analytical procedures extract contaminants attached to the sediments). A few contaminants are negatively correlated to suspended solids concentration; however, these may be spurious correlations given the apparent lack of correlation between flow and contaminant concentration and the strong correlation existing between streamflow and suspended solids. This is to be expected given the severe erosion problems of the central United States.

Louisiana Chemical Association Report

The Gulf South Research Institute prepared a report for the Louisiana Chemical Association on the factors affecting the water quality of the Mississippi River in Louisiana (Reference V-6). This report summarizes the water quality of the river, postulates on the factors that may be affecting the water quality and makes several recommendations concerning further characterization of the water quality of the river.

The report characterizes primarily the historical levels of conventional parameters (D.O., BOD, COD, solids, etc.). The heavy mass load of pollutants is identified as emanating upstream of Louisiana and passing through the state virtually unchanged. For all parameters surveyed, with the exception of total suspended solids (TSS), significant decreases in concentrations were identified over the period 1973 to 1981.

The report concludes that additional data should be collected to futher the characterization of the river. This data should include:

- horizontal and vertical samplings at frequent intervals
- estimates of the assimilative capacity of the river
- discharge data for municipalities, stormwater outlets, ships and barges, and from spills

The report also recommends that industries having raw water data should make this information available and that the state should implement a monitoring plan and a centralized warning network similar to that implemented by the Ohio River Valley Water Sanitation Commission (ORSANCO).

STATISTICAL ANALYSIS OF WATER QUALITY

Various statistical analyses were performed on the Lower Mississippi River water quality data base to further characterize the nature of the water quality; to assess the usability of the data in calibrating a water quality model; and to identify potential modifications in the ongoing monitoring programs to render the data more useful in a modeling context.

Temporal Variation in Water Quality

The temporal variation in water quality may be characterized by long term trends or cycles, and short term variations. Some general characteristics

are apparent from the time series plots of selected pollutants shown in Figures V-6 through V-10.

Figures V-6 and V-7 display the concentrations in the Mississippi River at Jefferson Parish (River Mile 105.4) for 1,2-dichloroethane and chloroform respectively over approximately a six year period from February 1977 through November 1983. Sampling occurred on average once per week with intermittent periods of no sample data available. The same two pollutants are plotted in Figures V-8 and V-9 for samples taken at New Orleans (River Mile 104.7) for a period from September 1980 through November 1983. On average, samples were available at the more frequent interval of once every two days. Figure V-10 is a time series plot of atrazine, a chlorinated herbicide, for the period of 1977 through 1979 as sampled at Jefferson Parish.

The previously described plots all indicate a significant short term, high frequency variation in concentrations. As illustrated, variations in concentration of 500 to 1000% between samples taken a few days or a week apart were not uncommon. The significant variation is reinforced by statistics derived from information presented in Table V-6. For the six constituents sampled at New Orleans, the ratio of standard deviation to mean, a normalized measure of variation known as the coefficient of variation, ranges from 1.47 to 8.21 while the ratio of maximum values to mean varies from 16.31 to 181.16. A third statistic is the percentage of samples in which the constituent is not detected (i.e., is equal to zero or below the detection limit). This statistic varies from 96% not detected to 19%. All three statistics indicate significant variations in the observed values of the constituents. The results are similar for the data collected at Jefferson Parish.

Analysis of the data at Jefferson Parish indicates a moderate general long term trend towards decreasing concentrations. This trend is apparent in the time series plot for 1,2-dichloroethane (Figure V-6) and less apparent for chloroform (Figure V-7). When yearly averages are plotted for selected constituents (Figure V-11) the general trend is more recognizable. However, there are exceptions to the trend such as bromodichloromethane in which the average concentrations are increasing and other constituents such as chloroform and trichloroethylene where there is significant between year random variation rather than a general trend. Similar conclusions may be drawn from the plot in Figure V-12 in which the percentage of non zero (detectable) values are plotted by year.

No formal analysis of seasonal trends of concentrations was performed. However, examination of the time series plots in Figures V-6 through V-10 suggest higher peaks during the winter for 1,2-dichloroethane and chloroform and higher peaks for atrazine during the summer. The higher summer values for atrazine correspond to the normal period of application for the herbicide. Reasons for increased concentrations of 1,2-dichloroethane and chloroform during the winter are not apparent.

Lateral and Longitudinal Variations in Water Quality

Spatial variation in water quality may be characterized by differences in water quality in any of three dimensions: longitudinal (in the direction

FIGURE V - 6

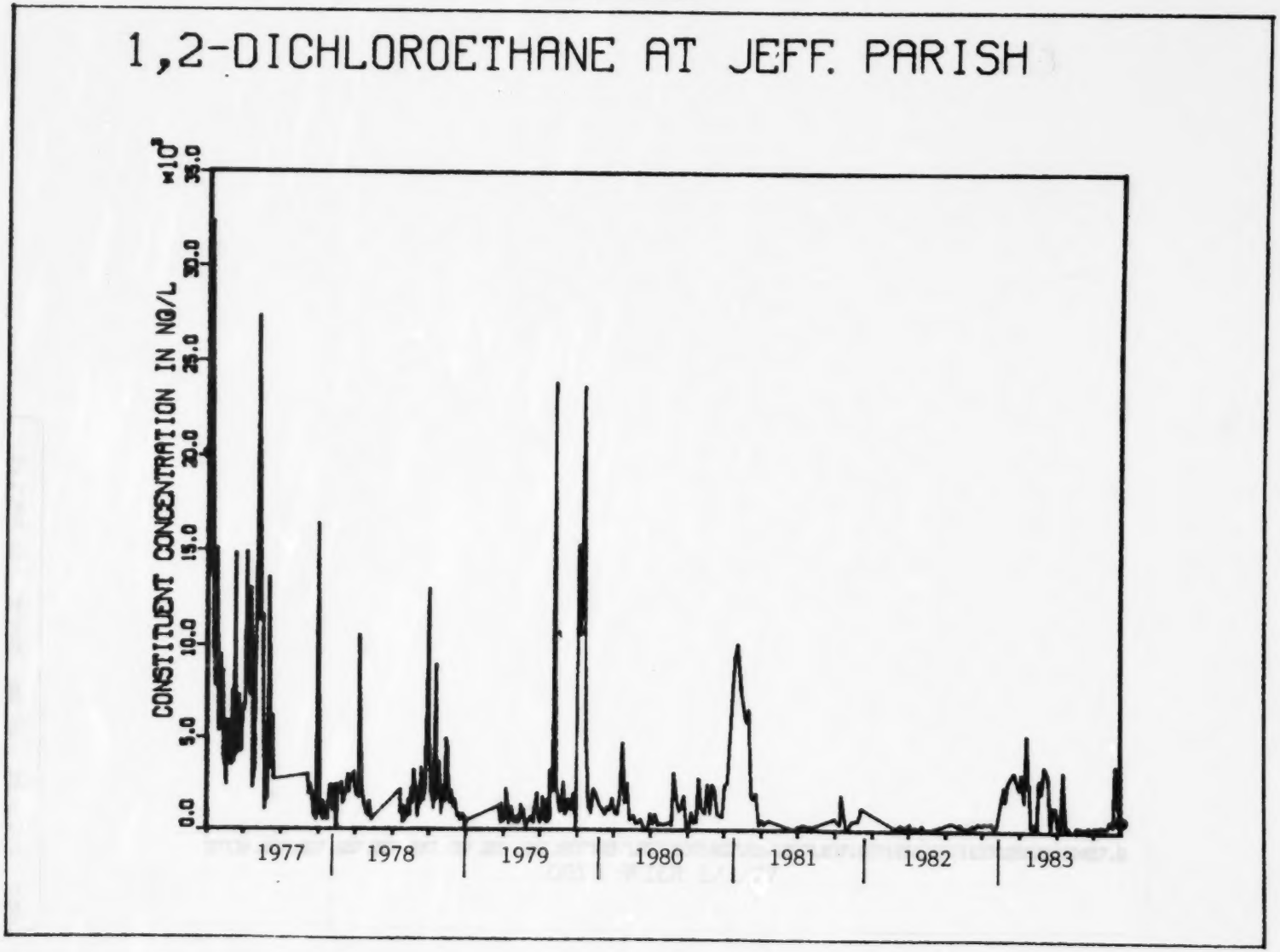

1,2-DICHLOROETHANE AT JEFF. PARISH
CONSTITUENT CONCENTRATION IN NG/L
x10³
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1977
1978
1979
1980
1981
1982
1983

FIGURE V - 7

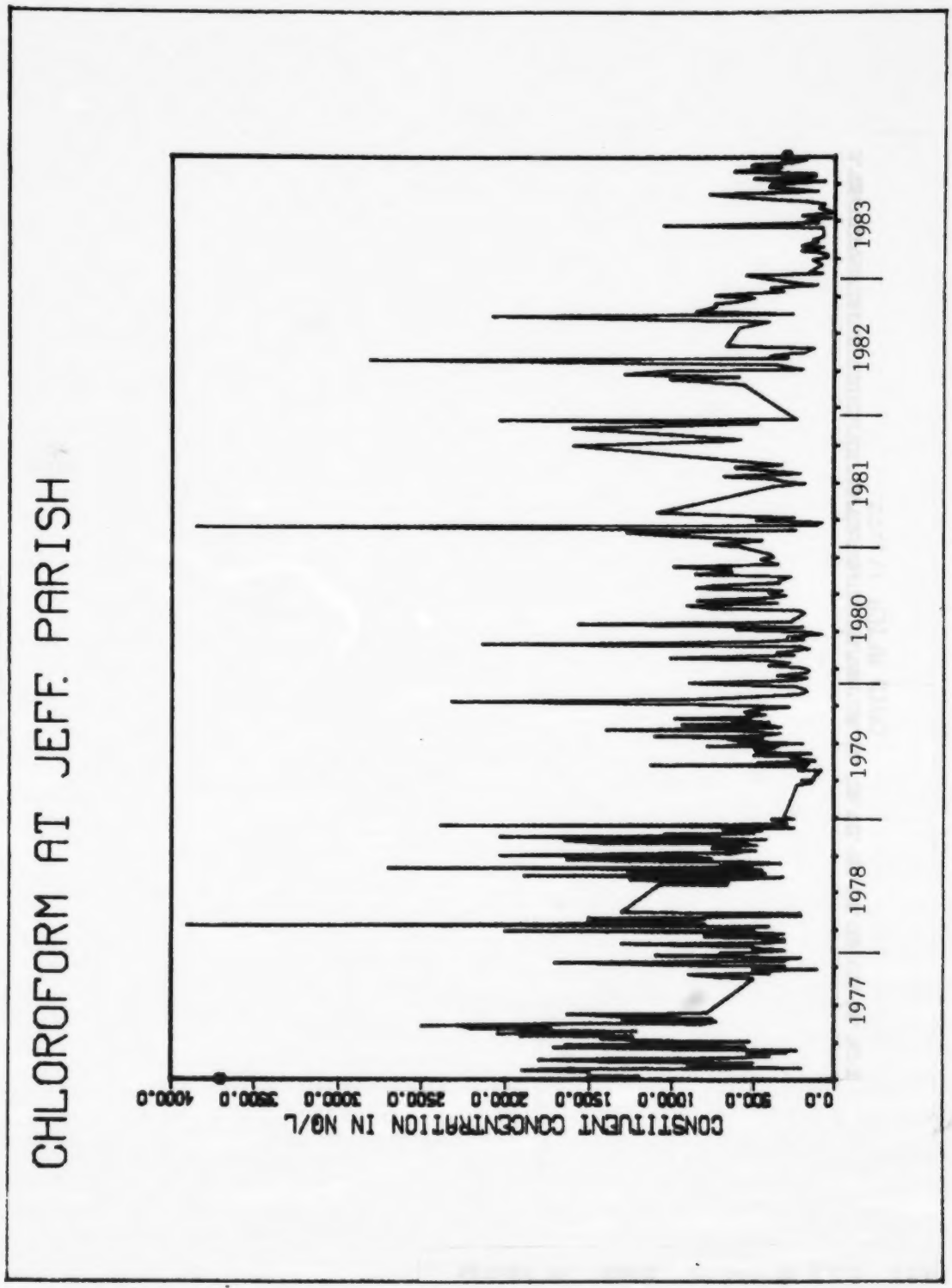

CHLOROFORM AT JEFF. PARISH
CONSTITUENT CONCENTRATION IN UG/L
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
1977
1978
1979
1980
1981
1982
1983

FIGURE V - 8

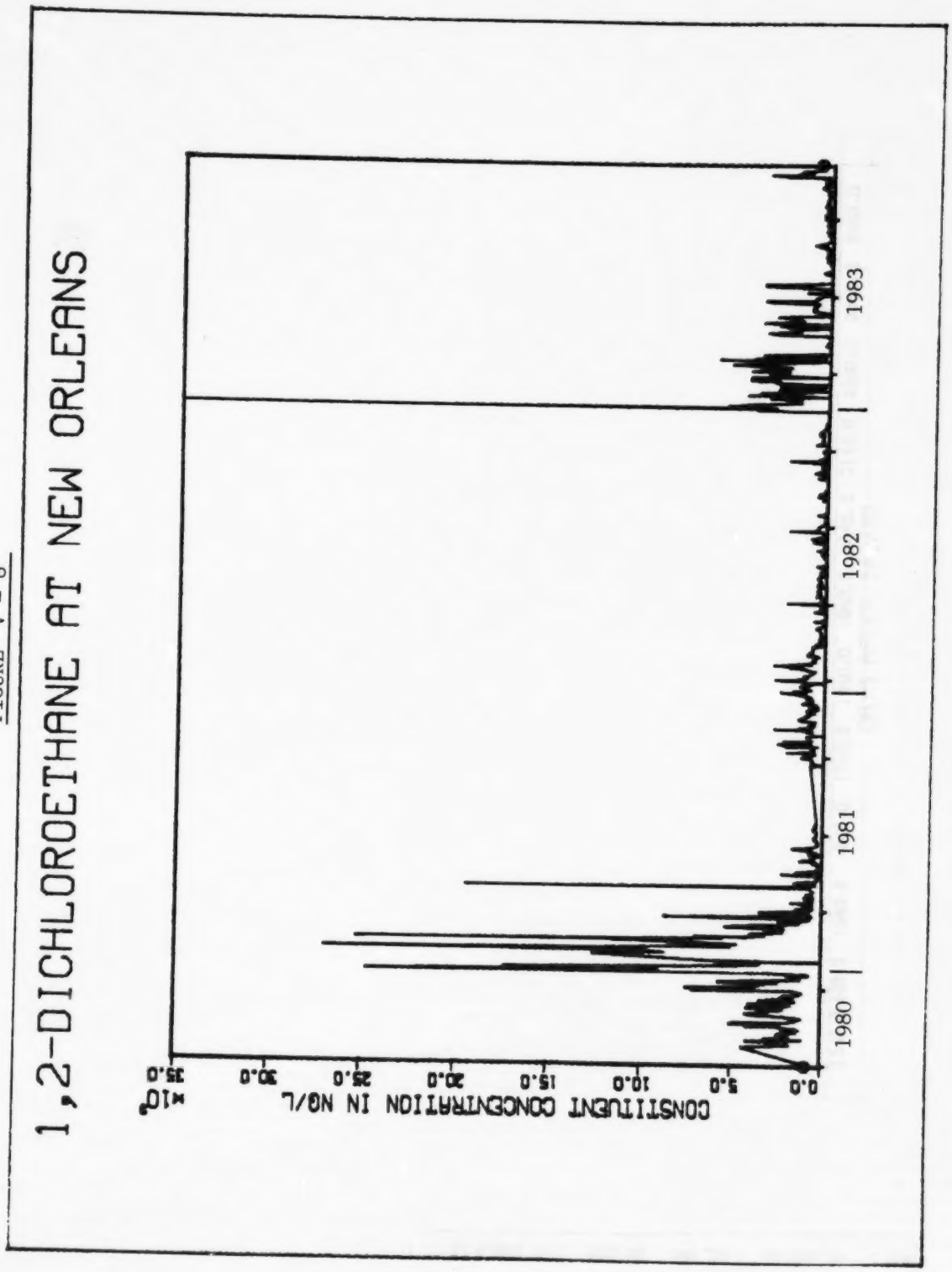

1,2-DICHLOROETHANE AT NEW ORLEANS
CONSTITUENT CONCENTRATION IN NG/L
x10⁰
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
1980
1981
1982
1983

FIGURE V - 9

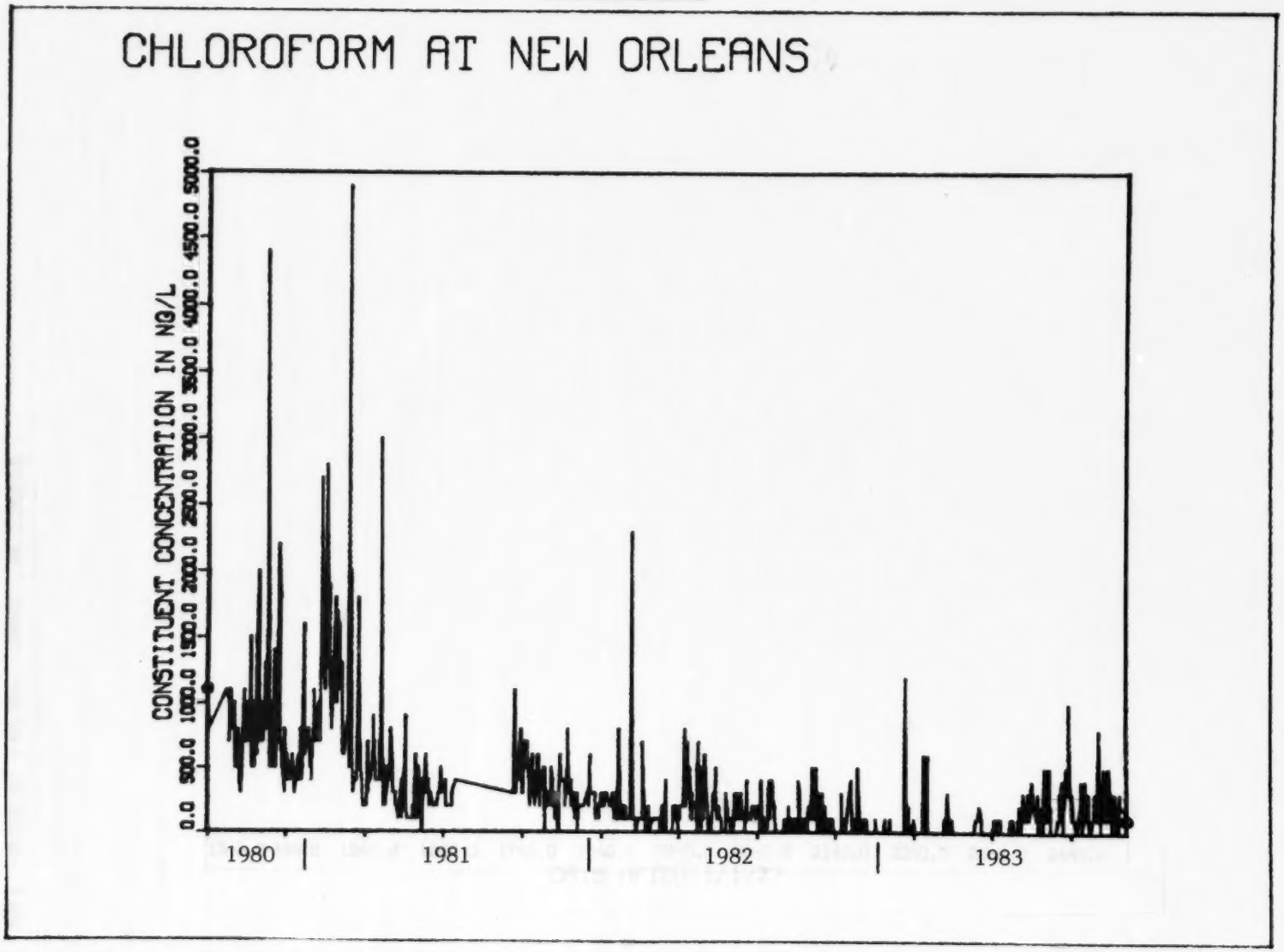

CHLOROFORM AT NEW ORLEANS
CONSTITUENT CONCENTRATION IN NG/L
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
4500.0
5000.0
1980
1981
1982
1983

FIGURE V - 10

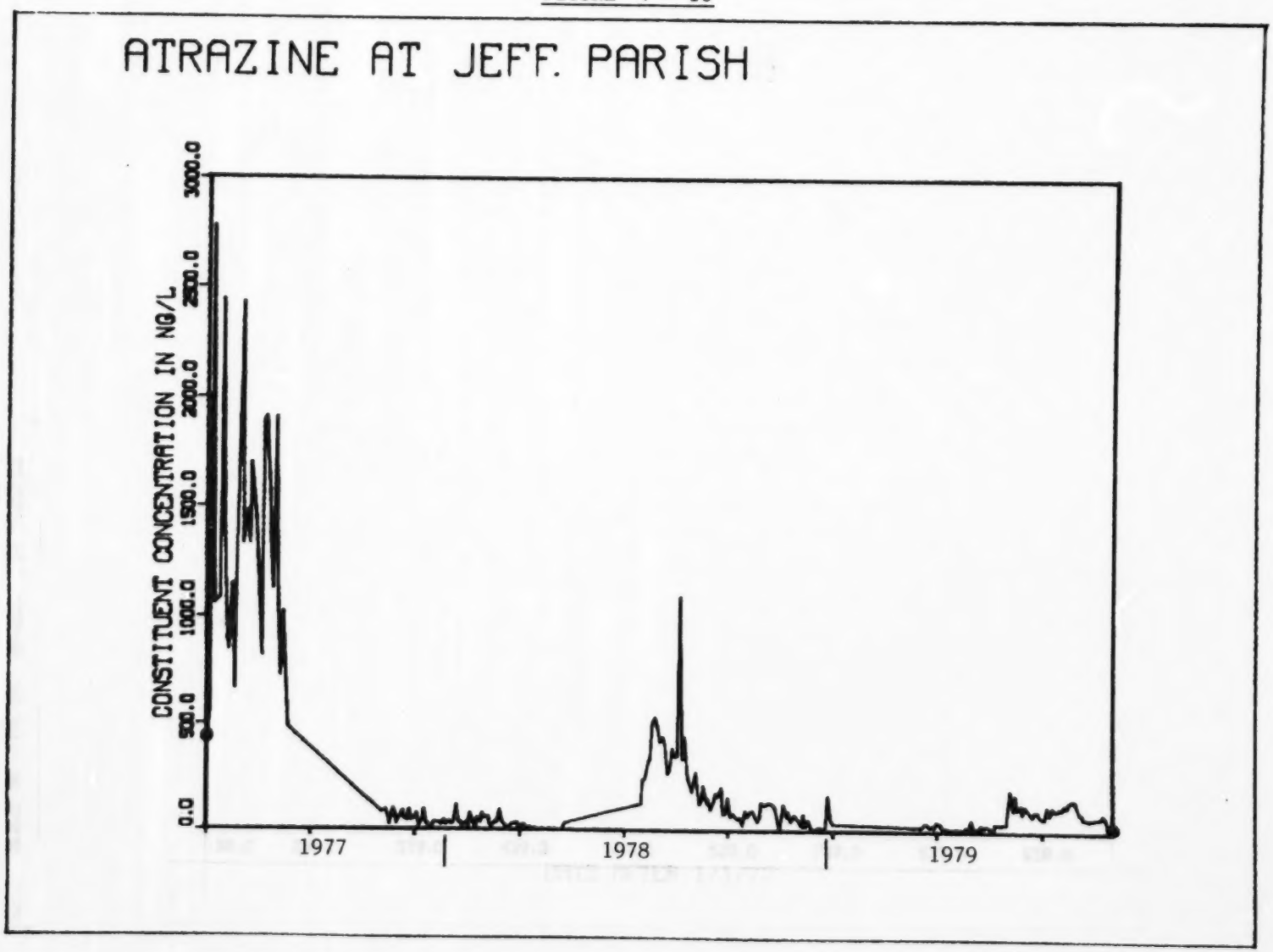

ATRAZINE AT JEFF. PARISH
CONSTITUENT CONCENTRATION IN NG/L
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
1977
1978
1979

TABLE V-6

STATISTICAL CHARACTERISTICS OF SELECTED POLLUTANTS AT NEW ORLEANS AND JEFFERSON PARISH

Jefferson Parish Sampling Data — Period: September 1980 - November 1983

No.	Constituent Name	No. of Observations	No. of Non-Zero Observations	Average (µg/L)	Standard Deviation (µg/L)	Minimum Value (µg/L)	Maximum Value (µg/L)
7	Chloroform	118	117	494.6	554.5	0.0	3850.0
11	Bromodichloromethane	118	76	192.0	308.5	0.0	1850.0
15	Chlorodibromomethane	118	14	16.7	66.2	0.0	470.0
19	Bromoform	58	1	0.3	2.6	0.0	20.0
23	1,2-Dichloroethane	118	111	1144.6	1801.6	0.0	10120.0
35	Trichloroethylene	118	67	65.6	179.0	0.0	1491.0
39	1,1,2-Trichloroethane	58	17	56.0	218.2	0.0	1570.0
43	Carbon Tet	118	39	18.8	61.2	0.0	600.0
47	Dichloromethane	58	29	66.9	130.7	0.0	740.0
50	Bromochloromethane	58	0	0.0	0.0	0.0	0.0
54	Dichloroethylene	58	0	0.0	0.0	0.0	0.0
58	Chlorobenzene	58	0	0.0	0.0	0.0	0.0
126	Tetrachloroethylene	58	0	0.0	0.0	0.0	0.0
134	1,1,2,2-Tetrachloroethane	58	0	0.0	0.0	0.0	0.0

New Orleans Sampling Data — Period: September 1980 - November 1983

7	Chloroform	847	600	300.4	440.9	0.0	4900.0
11	Bromodichloromethane	847	241	91.3	394.0	0.0	7100.0
15	Chlorodibromethane	847	37	13.8	95.9	0.0	2000.0
23	1,2-Dichloroethane	847	687	1363.0	2788.8	0.0	34800.0
35	Trichloroethylene	847	32	13.8	113.3	0.0	2500.0
43	Carbon Tet	847	93	27.1	130.7	0.0	1700.0

FIGURE V - 11

ANNUAL MEANS OF SELECTED POLLUTANTS AT JEFFERSON PARISH

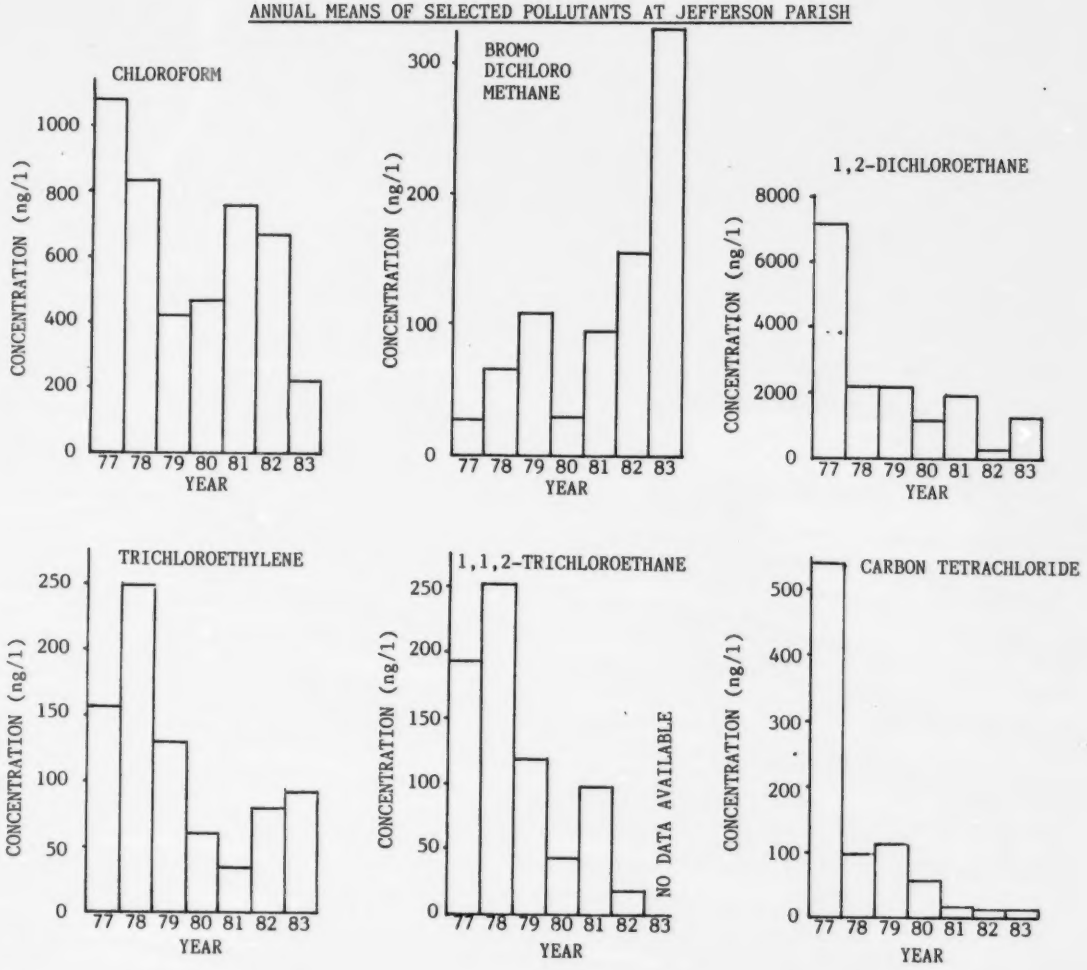
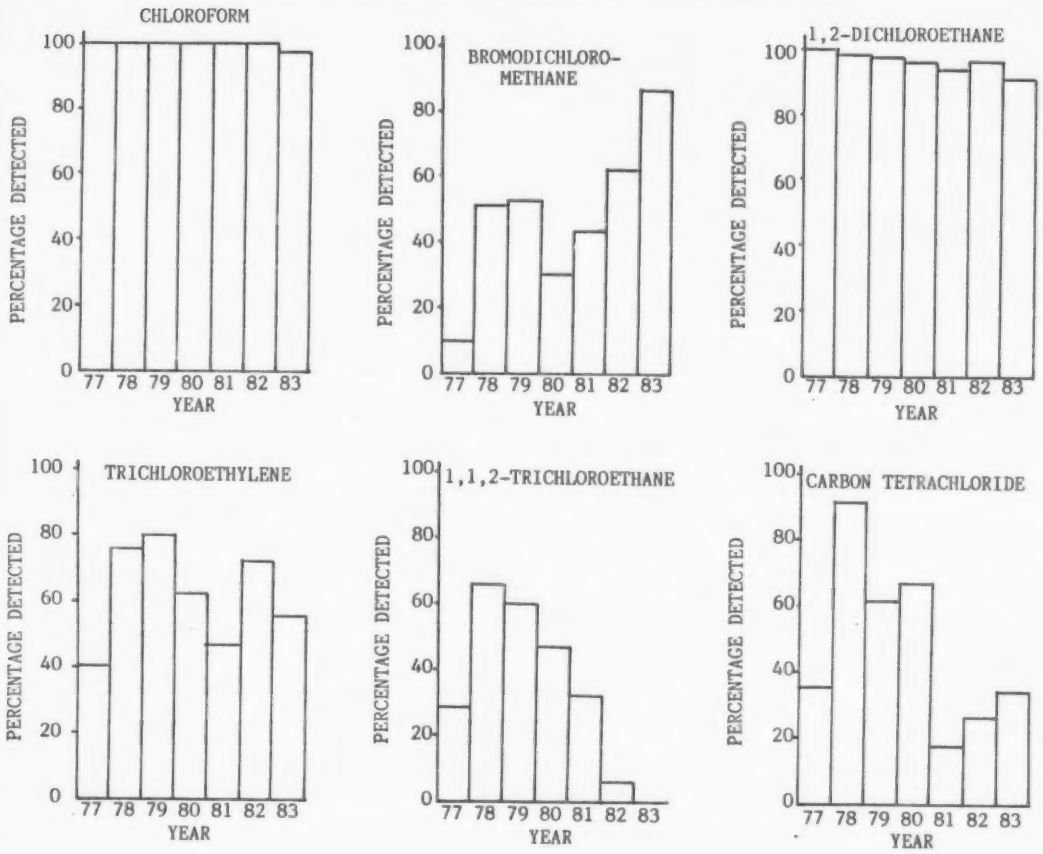


FIGURE V - 12

PERCENTAGE OF DETECTED POLLUTANTS AT JEFFERSON PARISH



of primary advective flow), lateral (horizontally perpendicular to the direction of primary advective flow) and vertical. In a riverine environment, primary emphasis is generally placed on longitudinal variations, namely, the changes in concentration at different river miles. Lateral and vertical variation is of importance in designing monitoring programs and determining the "near field" effects of discharges.

The sampling data collected and analyzed by the Louisiana Department of Natural Resources provides a potential resource for analyzing the longitudinal and lateral variations in water quality of the Mississippi River. Figures V-13 and V-14 contain time series plots of 1,2-dichloroethane and 1,1,1-trichloroethane respectively at Stations 1 (River Mile 266.8) and 5 (River Mile 177.1). Both concentrations and the occurrence of detectable levels of both constituents are greater at Station 5 which is in the vicinity of major industrial discharges than at Station 1 which is upstream of the developed Baton Rouge-New Orleans area. This same trend is apparent in the plot of average values of 1,2-dichloroethane and percentage of samples with detectable values at mid stream at different stations (Figure V-15) and in Table V-7. Definitive statements concerning longitudinal variation are limited by the relatively short time history of water quality data that is available (<10 months) and the reporting precision to only the nearest one microgram per liter (µg/L).

The average variation in lateral concentrations of 1,2-dichloroethane by station is shown graphically in Figure V-16. It would be expected that greater lateral variations in concentrations would occur in the vicinity of or just downstream of major discharges prior to full cross-sectional mixing. This plot does indicate the greatest homogeneity at Station 1 which is upstream of major discharges with divergence of average values at the other stations which are in the vicinity of industrial discharges. The differences in the average values and the raw data indicate sufficient variation such that consideration of lateral differences should be given in monitoring and modeling.

Correlation Between Constituents

Several means are available for determining whether sets of constituents are correlated (statistically related). If correlation exists, sampling requirements may be minimized by requiring only samples of the "independent" constituents. Additionally, other inferences may be drawn concerning the source and transformations of correlated constituents.

The relationships between two selected pairs of constituents are presented in scatter plots in Figures V-17 and V-18. These plots represent weekly sampling data from Jefferson Parish for the period from July 1978 to August 1982. In both cases, no significant visual relationships is apparent. This lack of relationship for these pairs and other pairs is reinforced by the pairwise correlation coefficients presented in Table V-8. Values of the correlation coefficient (R) vary from a high of 0.56 to a low of essentially zero with almost 80% of the absolute values of R less 0.1. A correlation of one indicates perfect relationship while zero indicates no statistical relationship. The calculated values indicate little significant relationship

FIGURE V - 13

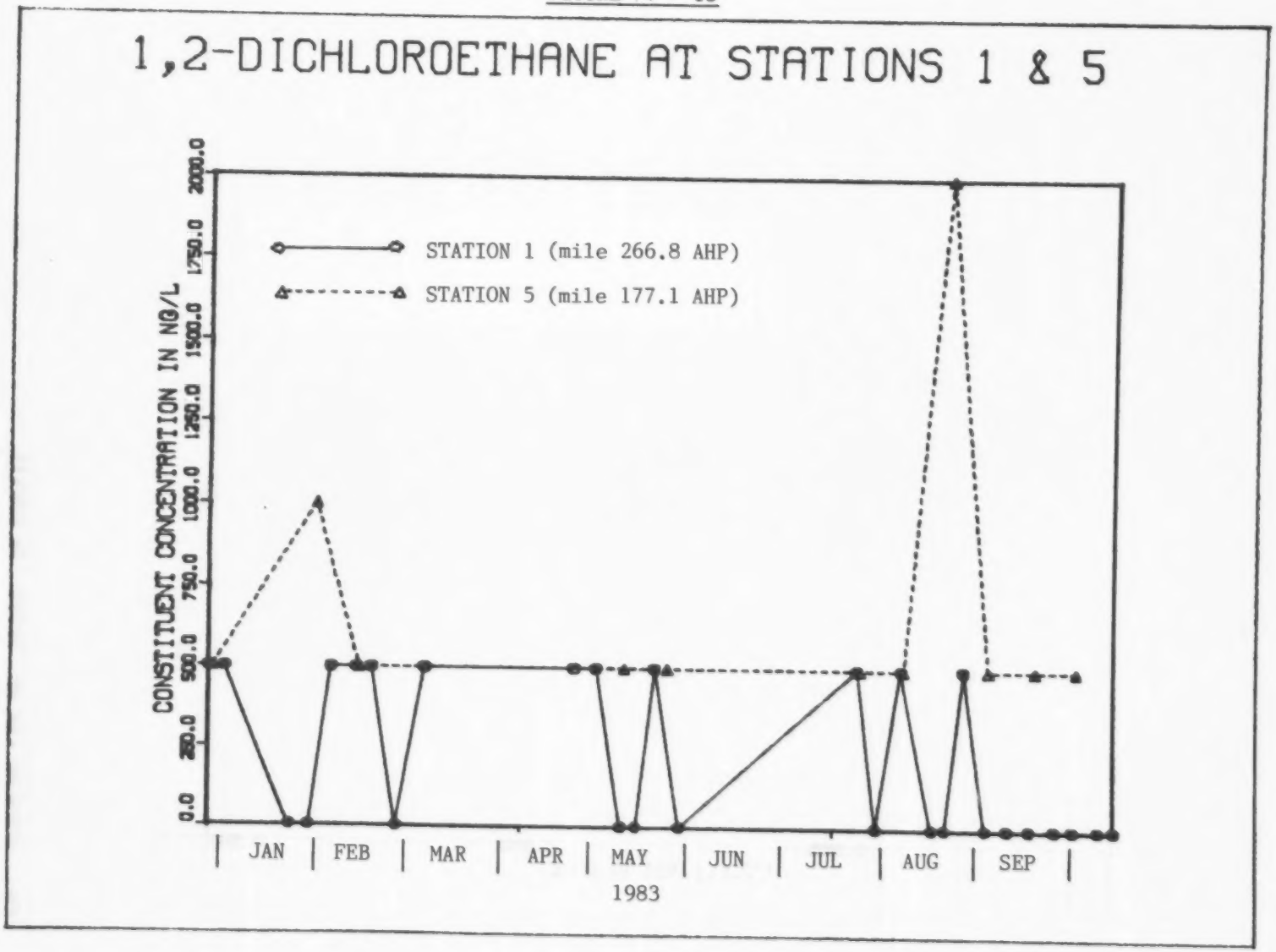

1,2-DICHLOROETHANE AT STATIONS 1 & 5
CONSTITUENT CONCENTRATION IN NG/L
0.0
250.0
500.0
750.0
1000.0
1250.0
1500.0
1750.0
2000.0
STATION 1 (mile 266.8 AHP)
STATION 5 (mile 177.1 AHP)
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
1983

FIGURE V - 14

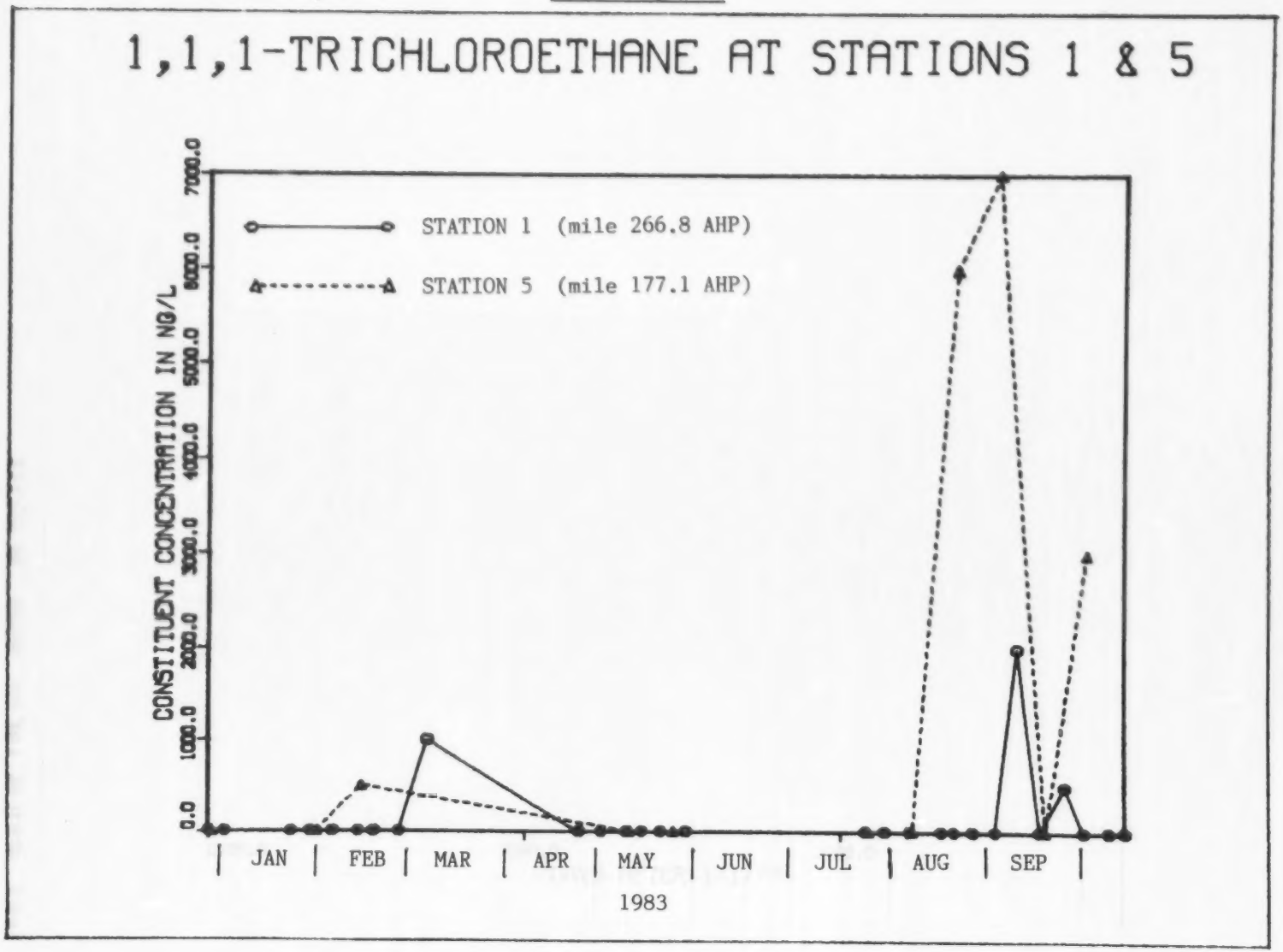

1,1,1-TRICHLOROETHANE AT STATIONS 1 & 5
STATION 1 (mile 266.8 AHP)
STATION 5 (mile 177.1 AHP)
CONSTITUENT CONCENTRATION IN NG/L
0.0
1000.0
2000.0
3000.0
4000.0
5000.0
6000.0
7000.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
1983

FIGURE V - 15

LONGITUDINAL VARIATION IN AVERAGE CONCENTRATIONS OF 1,2-DICHLOROETHANE

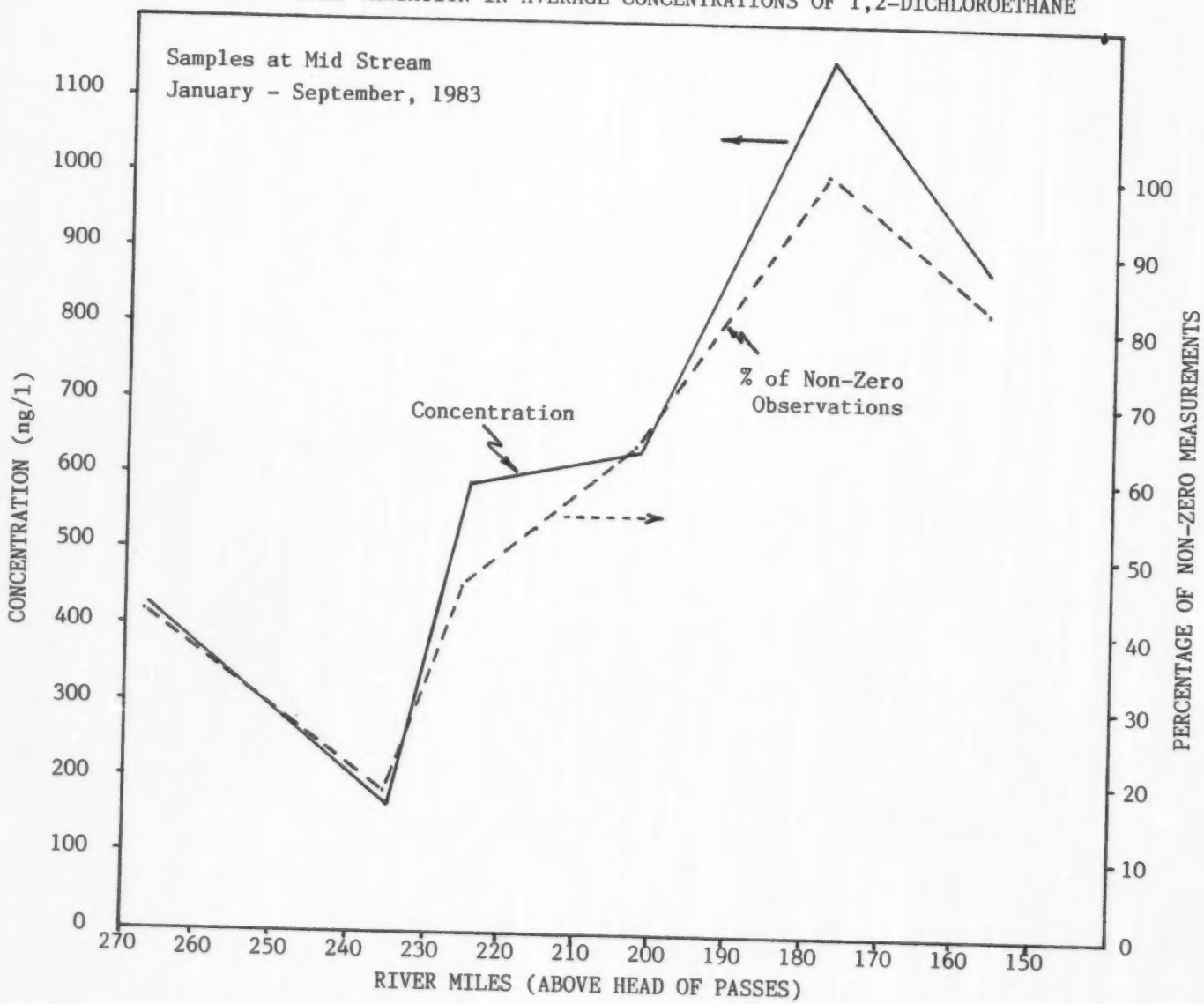


TABLE V-7

ANALYSIS OF SELECTED CONSTITUENTS SAMPLED BY LDNR 1983

Constituent	Statistic	Station 1 RM 266.8	Station 2 RM 234.5	Station 3 RM 224.6	Station 4 RM 202.1	Station 5 RM 177.1	Station 6 RM 155.6
1,2-Dichloroethane	Average (ng/L)	435	167	591	636	1100	864
(Poll. No. 23	% Not Detected	57	83	55	36	0	18
1,1,1-Trichloroethane	Average (ng/L)	174	917	636	1454	1700	1000
(Poll. No. 191)	% Not Detected	87	75	77	64	60	
Chloroform	Average (ng/L)	43	0	45	0	200	182
(Poll. No. 7)	% Not Detected	96	100	95	100	80	82
1,1-Dichloroethene	Average (ng/L)	217	917	364	.636	600	682
(Poll. No. 187	% Not Detected	78	58	82	82	80	73
Number of Samples		23	12	22	11	10	22

FIGURE V - 16

LATERAL VARIATIONS IN AVERAGE CONCENTRATIONS OF 1,2-DICHLOROETHANE

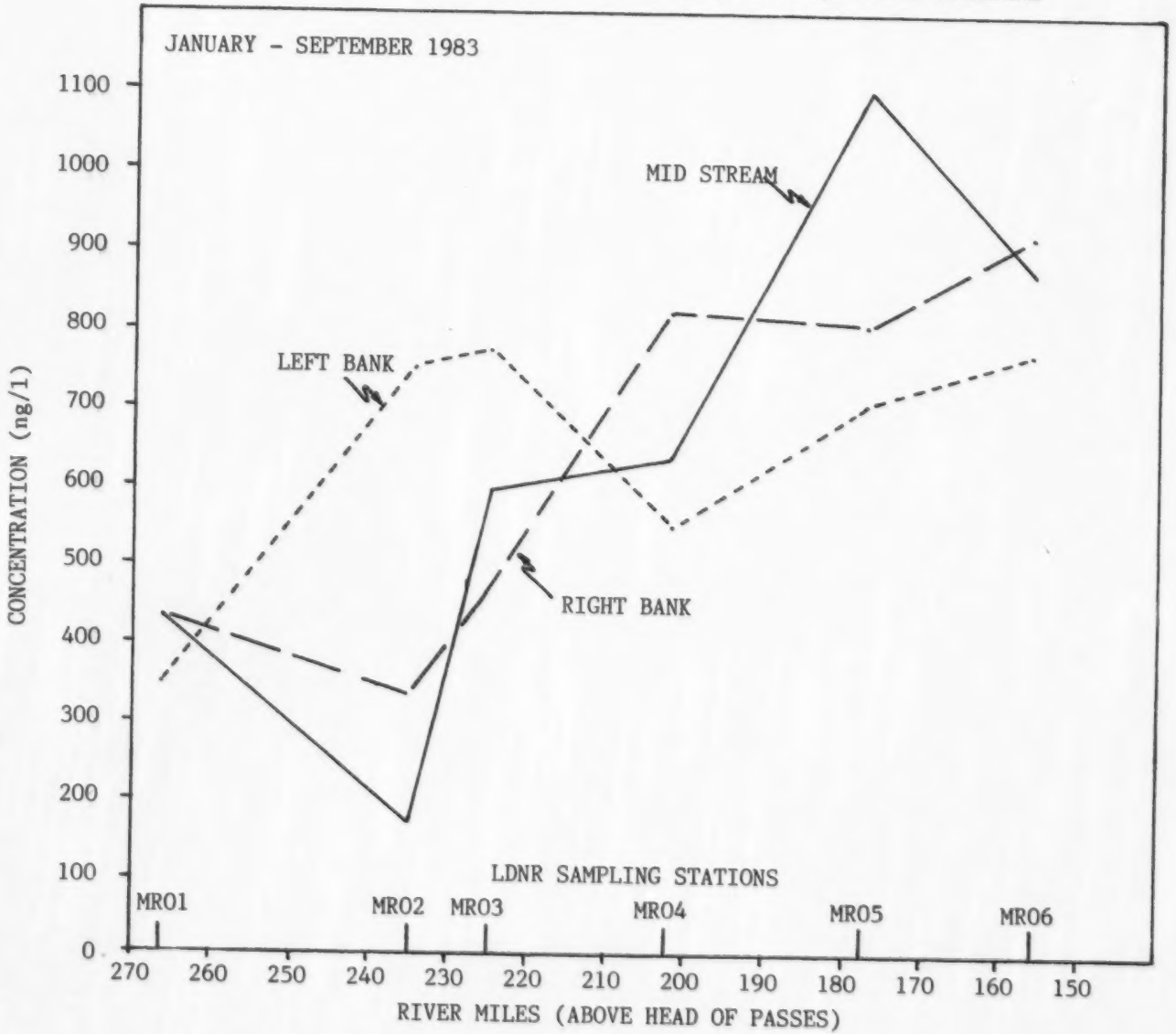


FIGURE V - 17

SCATTER DIAGRAM OF 1,2-DICHLOROETHANE AND DICHLOROMETHANE

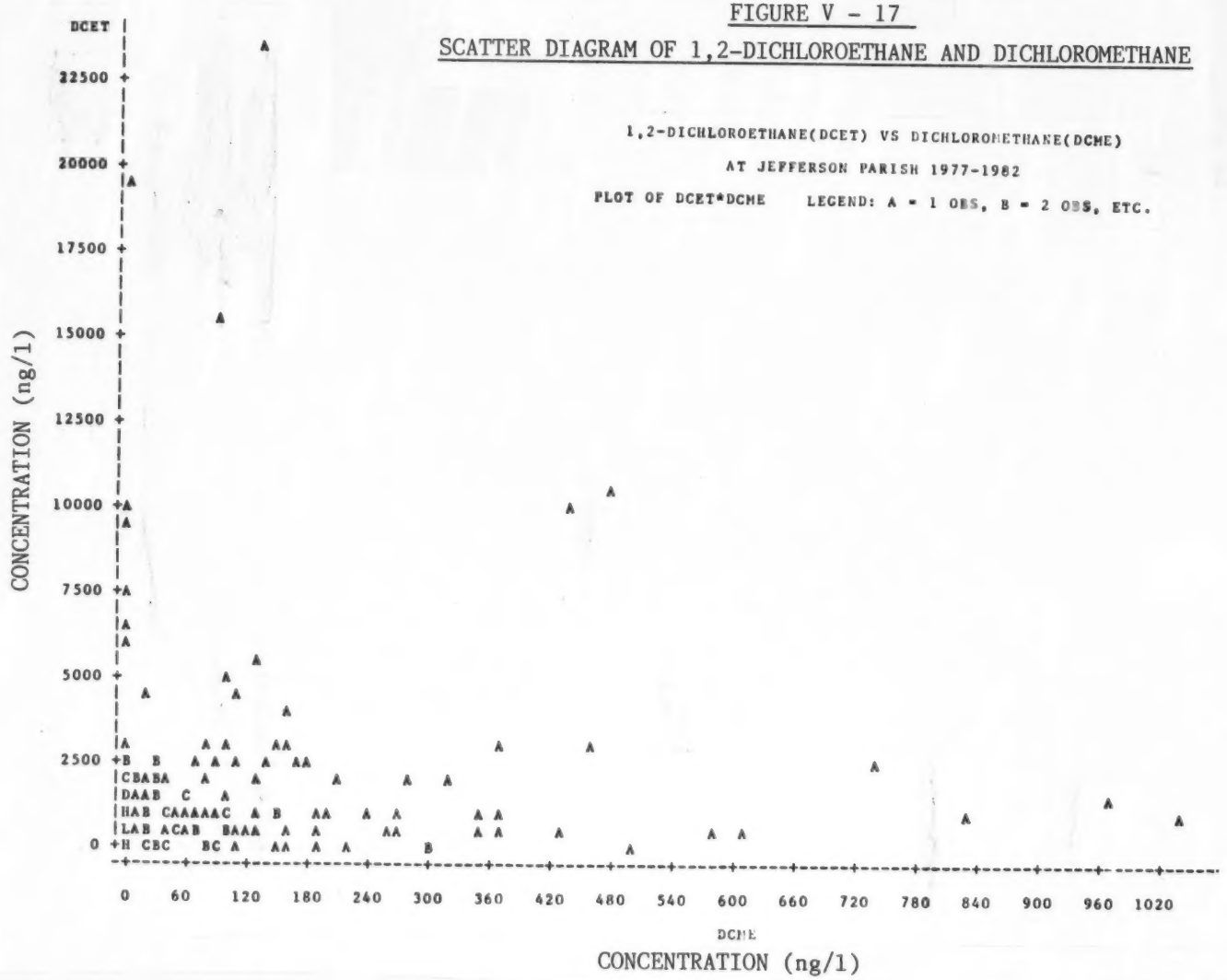


FIGURE V - 18

SCATTER DIAGRAM OF CHLOROFORM AND 1,1,2-TRICHLOROETHANE

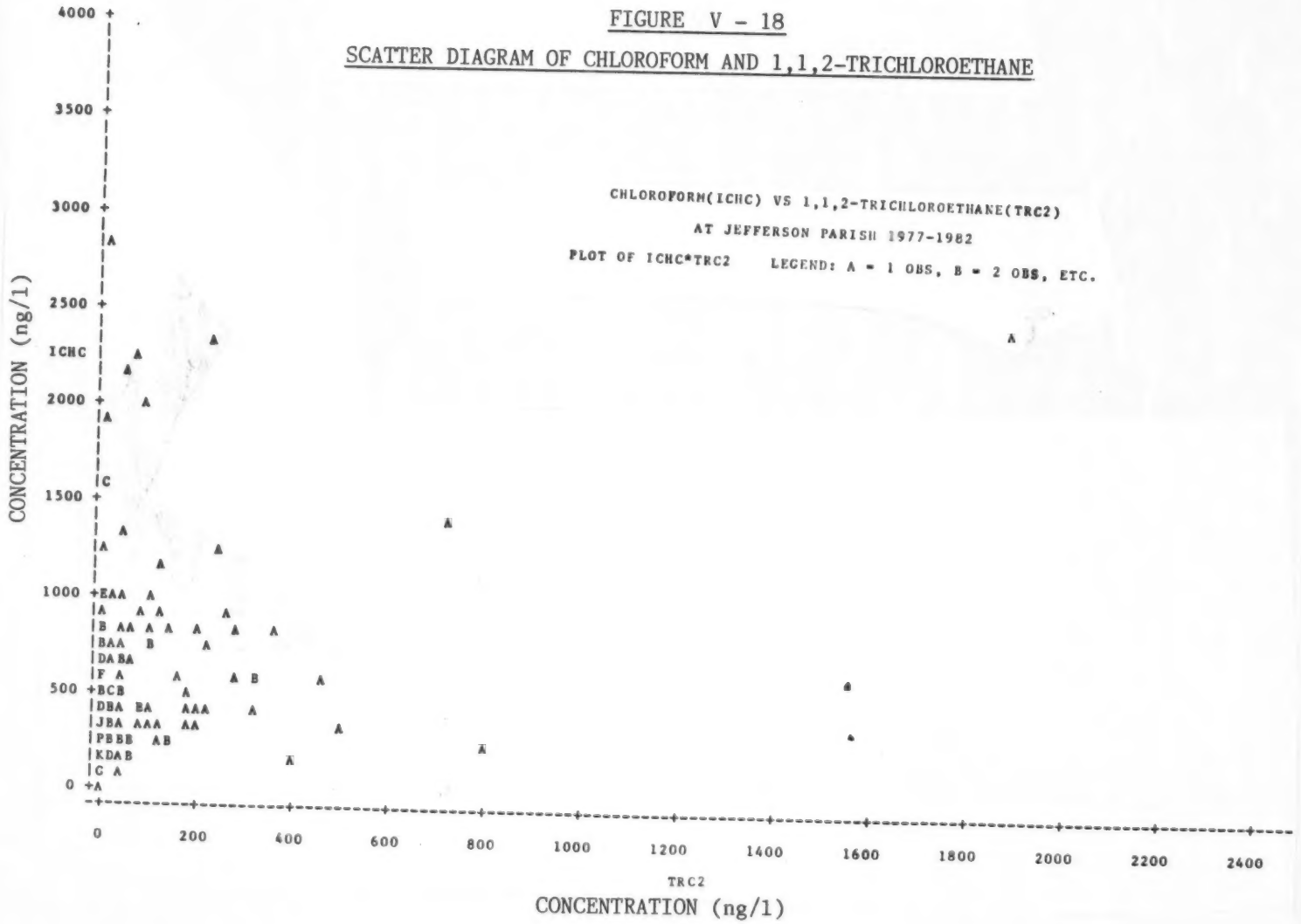


TABLE V-8

CORRELATION STATISTICS OF JEFFERSON PARISH DATA

Constituent	Poll. No.	% of Non-Zero Detected Values	DCE2 8	DCME 114	TCME 91	ICHC 158	BRCM 2	TRCE 103	IBR1 74	TCET 30	DCET 153	IBR2 51	TRC2 81	CLRB 1	IBR3 3	TECE 5
Dichloroethylene DCE2	54	34	-													
Dichloromethane DCME	47	72	0.04	-												
Tetrachloromethane (Carbon Tet) TCME	43	57	0.03	0.08	-											
Chloroform ICHC	7	100	0.16	0.07	0.01	-										
Bromochloromethane BRCM	50	1	-0.02	-0.04	0.04	0.24	-									
Trichloroethylene TRCE	35	65	0.06	0.08	0.02	0.06	0.02	-								
Bromodichloromethane IBR1	11	47	0.09	-0.07	-0.03	0.08	0.03	-0.00	-							
Tetrachloroethylene TCET	126	19	0.18	0.03	0.23	0.21	0.40	0.15	0.03	-						
1,2-Dichloroethane DCET	23	96	0.36	0.01	0.00	0.18	-0.02	0.01	0.02	0.08	-					
Chlorodibromomethane IBR2	15	32	0.04	0.26	0.18	0.06	-0.04	0.01	0.02	0.11	0.04	-				
1,1,2-Trichloroethane TRC2	39	51	0.32	0.00	0.12	0.40	-0.01	0.12	0.08	0.17	0.22	0.04	-			
Chlorobenzene CLRB	58	1	0.35	0.01	0.00	0.05	-0.01	-0.02	0.01	-0.03	0.56	-0.03	0.08	-		
Bromoform IBR3	19	2	0.01	0.00	-0.04	0.02	-0.01	0.07	0.02	-0.03	0.00	0.09	-0.02	-0.01	-	
1,1,2,2-Tetrachloroethane TECE	134	3	0.08	-0.01	-0.01	-0.02	-0.01	-0.02	0.01	-0.04	0.02	-0.02	-0.08	-0.01	-0.00	-

between observed concentrations of constituents. Similarly, low values of the correlation coefficient are reported for New Orleans data (Table V-9a).

Further investigation of the data was performed to identify whether any relationship exists between the joint occurrence of detectable levels of constituents rather than the magnitudes. For each sample, a detected presence in a sample was assigned a value of one and an undetected value was assigned a value of zero. Correlation analysis was applied to this transformed data set to determine whether a relationship exists. As reported in Table V-9b, no significant improvement in correlation was found.

Based on the correlation analyses it appears that little correlation exists among any of the available sample data.

Comparison Between Sampling Sites

The Mississippi River serves as a conduit transmitting and transforming pollutants along its course. In order to characterize its behavior, or develop/calibrate a model, data from sites along the river are required. The aforementioned, Louisiana Department of Natural Resources Sampling data serves as one source of such data. The sampling data from Jefferson Parish (River mile 105.4 AHP) and New Orleans (River mile 104.7 AHP) forms another pair of data points that may be used in this pursuit.

Figures V-19 and V-20 contain time series plots of concentration of New Orleans and Jefferson parish for 1,2-dichloroethane and chloroform respectively. In order to increase the legibility of the plot, sampling data has been averaged over a 7 day period and these weekly average values plotted. The plot of 1,2-dichloroethane shows good agreement between the two sites located 0.7 river miles apart on the same side of the river. Minor differences between the two traces are expected and may be caused by different sampling schedules, the averaging process, true longitudinal variation in concentrations or differences in the analytical methods. However, the variation between stations for chloroform is significantly greater with the disparity most apparent for the period from mid 1981 through mid 1983. Similar differences were found for bromodichoromethane and trichloroethylene. Though the differences may be partially explained by different sampling schedules, the averaging process or differences in concentrations due to transformations in the river it is probable that a significant portion of the disparity is due to differences in analytical procedures.

The other source of comparable data at stations along the Mississippi River is the Louisiana Department of Natural Resources (LDNR) monitoring data. This data is collected weekly by two boats. Example plots of the LDNR data were presented in Figures V-13 and V-14. This data is collected as both a means of identifying "spills" and as an historical record of the water quality of the Lower Mississippi River. As a means of identifying spills, the reporting precision to the nearest 1 µg/L is adequate. However, where logistically feasible, for analysis purposes the data would prove considerably more useful if reported to the nearest 0.1 µg/L - a technologically achievable level of precision. The utility of the monitoring data could also be improved by modifying the sample collection schedule such that samples are

TABLE V-9

CORRELATION STATISTICS OF NEW ORLEANS DATA

A) CORRELATION OF CONCENTRATIONS*

Constituent	Poll. No.	% of Non-Zero Values	Correlation Coefficient With TCME	ICHC	TRCE	IBR1	DCET	IBR2
Carbon Tetrachloride (TCME)	43	2	-					
Chloroform (ICHC)	7	96	0.25	-				
Trichloroethylene (TRCE)	35	6	0.06	0.25	-			
Bromodichloromethane (IBR1)	11	55	0.05	0.17	0.05	-		
1,2-Dichloroethane (DCET)	23	92	0.29	0.40	0.20	0.04	-	
Dibromochloromethane (IBR2)	15	7	0.08	0.18	0.29	0.05	0.21	-

B) CORRELATION OF OCCURRENCES*

Constituent	Poll. No.	% of Non-Zero Values	Correlation Coefficient With TCME	ICHC	TRCE	IBR1	DCET	IBR2
Carbon Tetrachloride (TCME)	43	2	-					
Chloroform (ICHC)	7	96	0.08	-				
Trichloroethylene (TRCE)	35	6	0.15	0.05	-			
Bromodichloromethane (IBR1)	11	55	0.20	0.22	0.15	-		
1,2-Dichloroethane (DCET)	23	92	0.10	0.63	0.05	0.21	-	
Dibromochloromethane (IBR2)	15	7	0.23	0.06	0.27	0.17	0.09	-

*Based on 547 observations 9/80 - 8/82

FIGURE V - 19

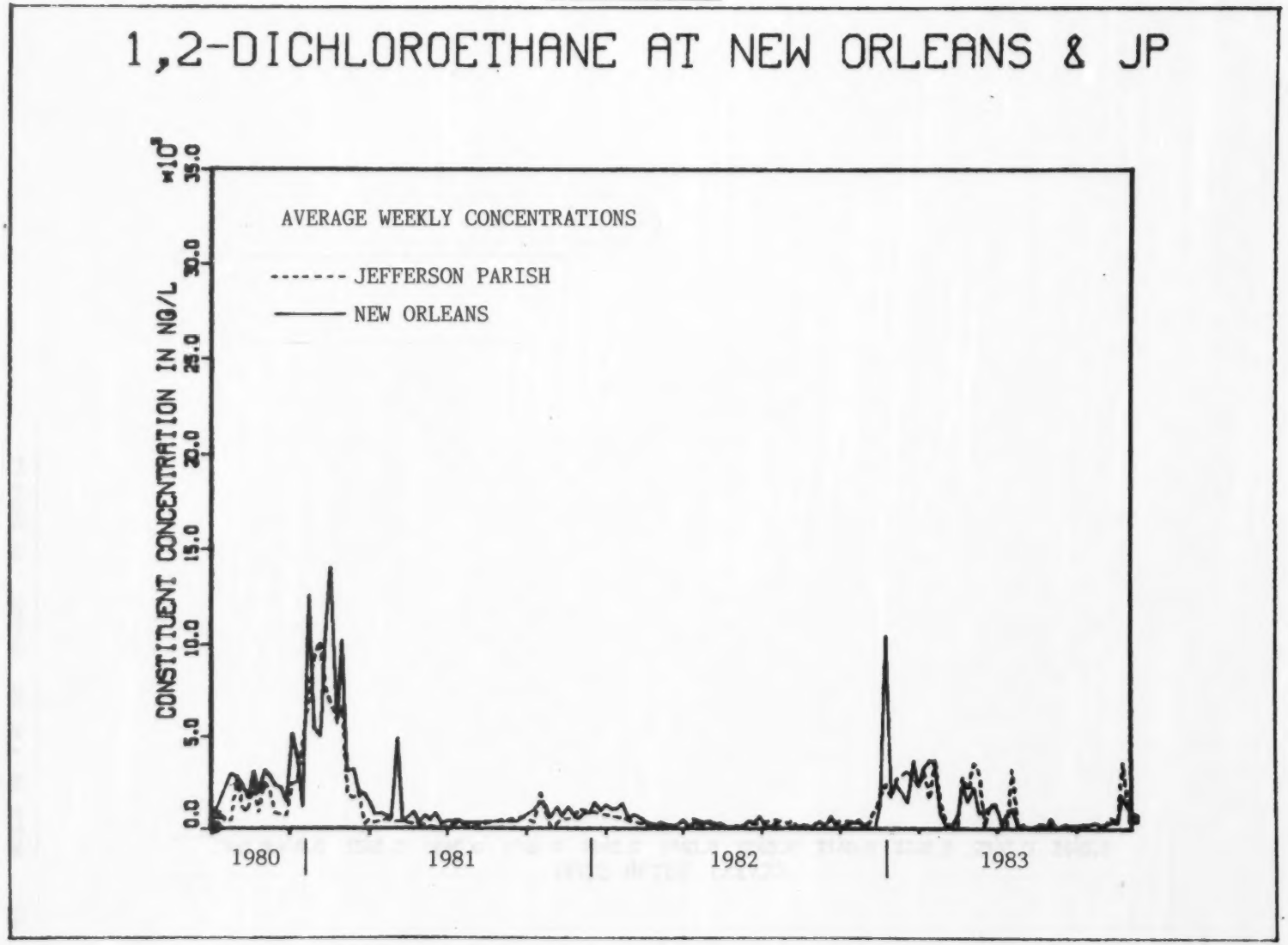
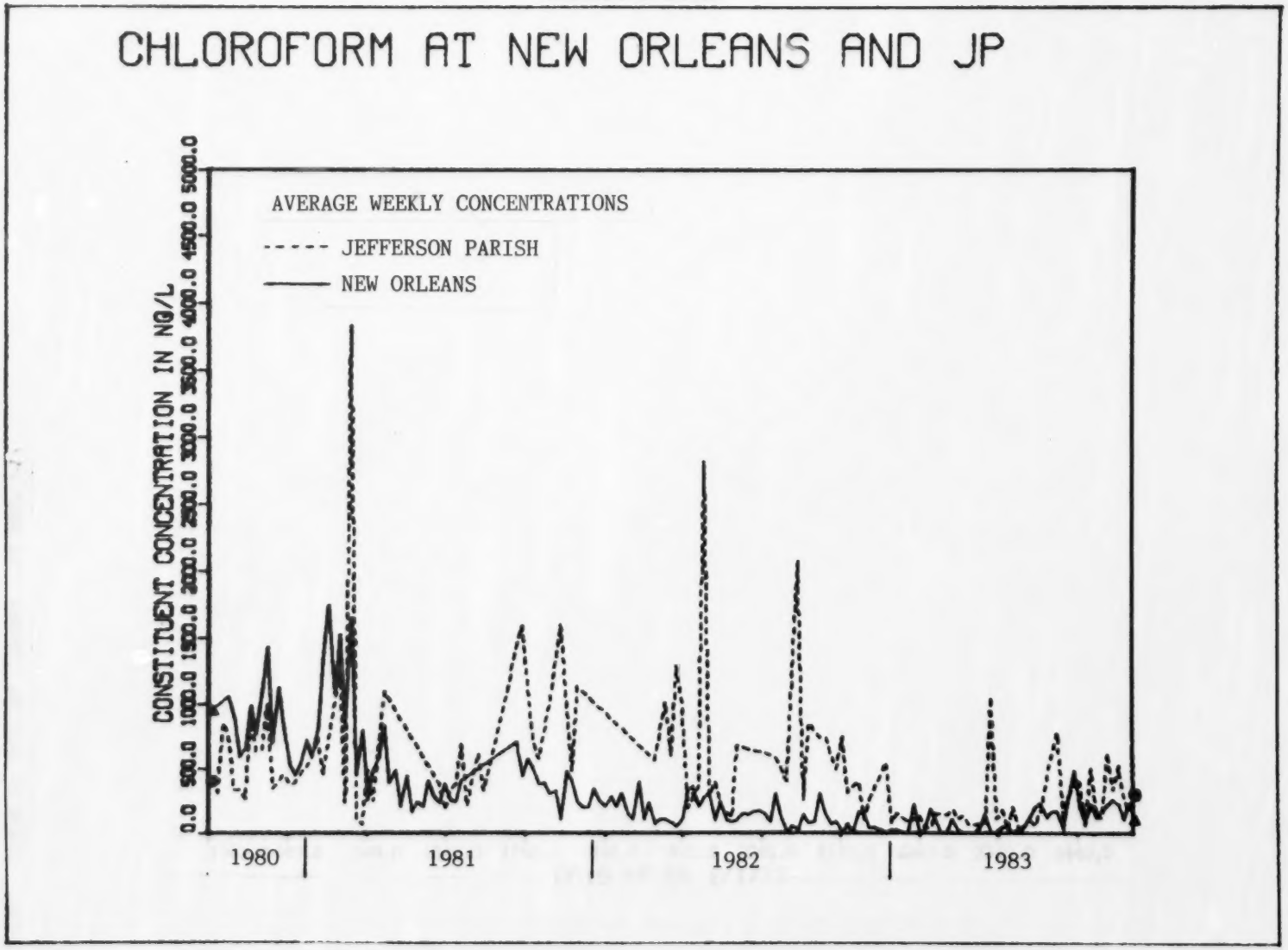

1,2-DICHLOROETHANE AT NEW ORLEANS & JP
AVERAGE WEEKLY CONCENTRATIONS
JEFFERSON PARISH
NEW ORLEANS
CONSTITUENT CONCENTRATION IN NG/L
x10³
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1980
1981
1982
1983

FIGURE V - 20


CHLOROFORM AT NEW ORLEANS AND JP
AVERAGE WEEKLY CONCENTRATIONS
JEFFERSON PARISH
NEW ORLEANS
CONSTITUENT CONCENTRATION IN NG/L
0.0 500.0 1000.0 1500.0 2000.0 2500.0 3000.0 3500.0 4000.0 4500.0 5000.0
1980
1981
1982
1983

taken corresponding to the approximate travel time between stations. By this method, the same "packet" of water would be sampled at subsequent stations and changes in quality due to within-stream transformations or discharges could be readily identified.

The general comparability of data between the State, Jefferson Parish, New Orleans and other potential sources such as industrial labs could be improved by the institution of a joint quality control/assurance program. Such a procedure would result in data sets which could be utilized with confidence to trace the longitudinal variation in the water quality of the Lower Mississippi River.

SUMMARY

Several general characteristics have been identified concerning the water quality of the Lower Mississippi River. Most significant among these characteristics are the following:

- significant high frequency, short term variations are apparent in the concentration of many organics.
- a long term general trend towards decreasing concentrations of organics is occurring. However, some constituents are not following this general trend and are in fact increasing, while other constituents are varying significantly with no apparent long term trend.
- little statistical correlation between constituents appear to exist.

Detailed ongoing sampling programs for organics are being conducted by the Louisiana Department of Natural Resources, the New Orleans Sewerage and Water Board and the Jefferson Parish Department of Utilities. The results of these programs can be maximized, with minor modifications and little additional expense by:

- establishing a coordinated quality control program to insure comparability of sample results;
- modifying sampling schedules to allow more direct comparison of sampling data and to develop/calibrate a model describing the instream transport/transformation of organics;
- increased reporting precision for the LDNR samples (i.e., to the nearest 0.1 µg/L instead of to the nearest 1 µg/L).

REFERENCES

V-1. USEPA, "Statistical Analysis for Selected Organic Pollutants in the Lower Mississippi River", Environmental Analysis Section, Surveillance Branch, USEPA Region VI, Dallas, TX, September 1982.

V-2. Flores, M. J., "Analysis of Organic Compound Levels in the Lower Mississippi River at Jefferson Parish 1977-1979", Environmental Analysis Section, Surveillance Branch, USEPA Region VI, Dallas, TX, January 1983.

V-3. Koffskey, W. E., and N. V. Brodtmann, "Organic Contaminant Removal in Lower Mississippi River Drinking Water by Granular Activated Carbon Adsorption", USEPA, MERL, Cincinnati, OH, 1983.

V-4. Louisiana Department of Natural Resources, "A Report to Governor David C. Treen On the Occurrence of 1,2-Dichloroethane (EDC) in the Mississippi River for the Period from September 1980 to September 1981", LDNR, Office of Environmental Affairs, Water Pollution Control Division, Baton Rouge, LA, December 1981.

V-5. Grayman, W. M., J. G. Sarsenski, P. J. Wehrman, P. D. Koch, "Conceptual Development of a Toxic Screening Model", USEPA, MERL, Cincinnati, OH, 1984.

V-6. Gulf South Research Institute, "Factor Affecting Water Quality of the Mississippi River in Louisiana", Louisiana Chemical Assoc., Baton Rouge, LA, May 1982.

CHAPTER VI

AVAILABLE MODELS AND METHODS

INTRODUCTION

Over the past 25 years, the development and use of computer based mathematical models of the movement and transformation of pollutants in streams, lakes and estuaries has been quite extensive. In more recent years, models directed towards tracing organics, pesticides and other toxics have been developed. These models form the pool of currently available tools that may serve as the basis for modeling of the Lower Mississippi River.

In this chapter, an overview is presented of the general characteristics and organization of water quality models with emphasis upon organic modeling within free flowing rivers. Specific descriptions of several representative models and methods are presented. This review is not intended to be an exhaustive review but rather is to provide an overview of the available models and the characteristics to be considered in evaluating, selecting or developing models.

MODELING OVERVIEW

The process of modeling a physical system, either by use of physical models or by mathematical models, is an abstraction process by which the "real world" system is portrayed by a simplified representation. Models are generally used as a means of studying the behavior of a physical system under varying conditions. The general applicability of a model for a particular situation may be measured by the accuracy of the model (ability to reproduce the response of the real world), the flexibility of the model to represent desired circumstances, and the availability of the data and parameters required to adjust the model. Thus, selection of a model for a particular application must be tailored to the specific requirements of the application and must consider the model costs and flexibility, and availability of data.

Mathematical modeling systems should be considered within the overall framework of their use. A model requires information on the physical system it is to represent. For example, in modeling a river, this description may include the physical characteristics of the stream such as width and slope, the location and characteristics of flow and pollutants entering the stream, and parameters describing the chemical processes occurring within the stream. The model may then use this information to predict the behavior of the stream

at various stream locations at different times. Where actual system information is available, the model results can then be compared to the physical data to determine the validity of the model and to make adjustments as required.

Within this context of the model as part of an overall application framework, two general methods have emerged: the model centered approach and the data centered approach. Within the model-centered approach, the direct needs of the model define the data types and format. In this approach, common to most model applications, an "input card deck" describing the physical system is prepared and fed into the model. Results of the model applications may be analyzed or reorganized and used as input to other models. In a data-centered approach, information may be organized in a manner suitable to the available data and put in a data base available to several models. Furthermore, the results of the model applications may be put directly into the data base and thus be available for further analysis. The distinction between the model centered approach and the data-centered approach is shown schematically in Figure VI-1. The application of these two modeling approaches is emphasized in the discussion of specific models later in this chapter.

Models used in studying the movement and transformation of pollutants in a water body are generally composed of two components: hydraulic component and water quality component. The hydraulic component is used to calculate the spatial and temporal variation of discharge and depth within the water body. The water quality component is used to determine the spatial and temporal variation of pollutant concentrations in the water body. In general, the water quality component uses hydraulic information provided by the hydraulic component or through direct measurement. Hydraulic and water quality models may be steady state or temporally dynamic. In a steady state model, all inflows are set at a constant value and the spatial distribution of flow and concentration resulting from these temporally constant inputs are calculated. In a dynamic model, inputs may vary with time and the resulting spatial and temporal distributions of flow and concentration are determined. Selection of a steady state or dynamic model is generally dictated by the ultimate use of the model results and the relative temporal variability in the inflows.

In the following sections, the characteristics of water quality and hydraulic models are discussed and representative examples are presented.

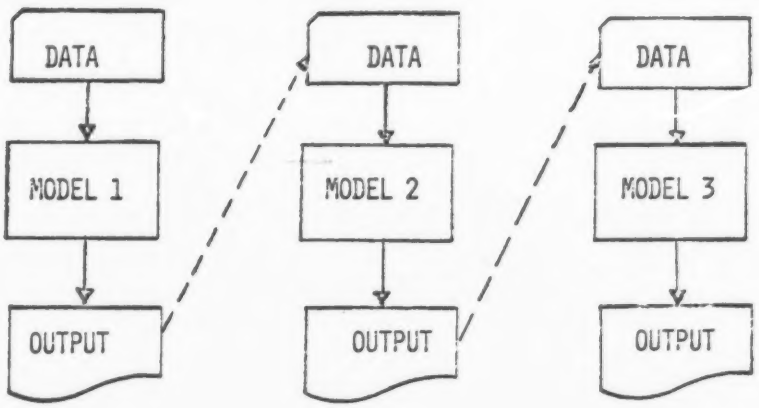
WATER QUALITY MODELS

Water quality models are utilized to determine the movement and transformation of pollutants in a water body. They are characterized by their temporal representation (i.e., the previously described steady state or dynamic model), their model-data orientation (i.e., model-centered or data-centered), their spatial dimensionality, and the type of pollutants and processes represented.

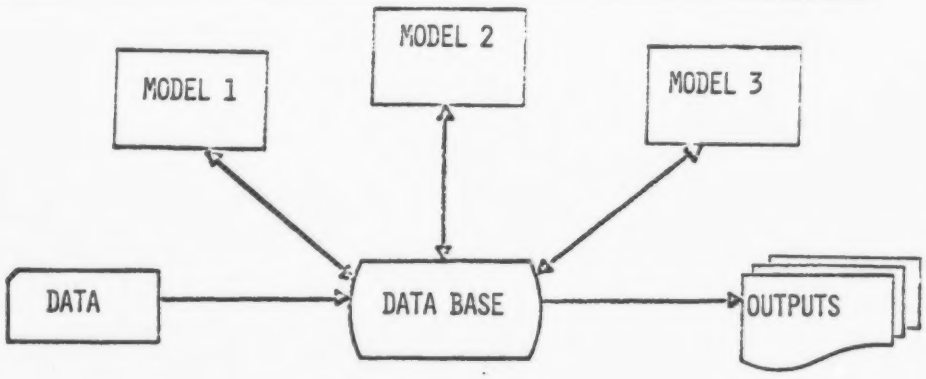
The spatial dimensionality of the model refers to the number of dimensions that are explicitly represented in the model. A one-dimensional model is generally applicable to a river where the primary variability and movement

FIGURE VI - 1

MODEL-CENTERED VS. DATA-CENTERED ORGANIZATION



MODEL-CENTERED ORGANIZATION



DATA-CENTERED ORGANIZATION

is in the longitudinal direction. Two dimensional models may be applied in wide streams or lakes where variability in the longitudinal and lateral directions (i.e., X and Y) are potentially significant or in estuaries or deep streams where the longitudinal and vertical variability must be presented. Finally, water bodies in which the variability is significant and of particular importance in all three directions may be represented by a three dimensional model.

Up to approximately a decade ago, water quality modeling dealt primarily with what may be termed "conventional pollutants". This category included those pollutants most commonly regulated by the permit system such as B.O.D.-D.O., solids and conservative constituents. More recently, regulation and modeling of the so-called micro-contaminants such as organics and toxic substances has occurred. This type of modeling requires the representation of such complex processes as volatization, hydrolysis etc. Other substances and processes that have been modeled include the sedimentation/ benthic domain and biological processes. In general, the accuracy of the modeling capacity decreases with the more complex processes while the difficulty, cost and uncertainty increases as the complexity increases. However, this does not decrease the value of such modeling, and, in fact, as more such modeling is performed the body of knowledge increases thus improving the prospects for accurately predicting the fate of such constituents in the water bodies.

In the remainder of this section, several examples of water quality models are described. The models described herein were selected because of their likely applicability to the Lower Mississippi River. The Routing and Graphical Display System (RGDS) has been applied in conjunction with the Reach File for preliminary modeling of the Lower Mississippi River. The Water Quality Analysis Simulation Program (WASP), the Exposure Analysis Modeling System (EXAMS), TOXIWASP and the Sediment Contaminant Transport Model (SERATRA) are generally considered as EPA's state-of-the-art models. Other models, that are potentially applicable to the Lower Mississippi are listed.

Routing and Graphical Display System (RGDS)

The Routing and Graphical Display System (RGDS) is a modular set of computer based files and programs developed by W. E. Gates and Associates for USEPA (Ref. VI-1). RGDS performs routing of pollutants through a stream network and produces a variety of graphical displays of information generated by the routing process or other information stored in USEPA maintained data files. The system is a true data centered system with the files serving as the central focus and the routing and graphical programs utilizing information from the files and storing information in the files for further analysis and display.

The major components within RGDS are illustrated in Figure VI-2. The three major files utilized by RGDS, the Analytical Reach File (AR FIle), the Industrial Facilities Discharge File (IFD) and the Pollutant Matrix file (PMF) contain information on the connectivity and characteristics of the stream network, major dischargers, and representative values of concentration of selected pollutants in discharges by industrial category. The Reach File

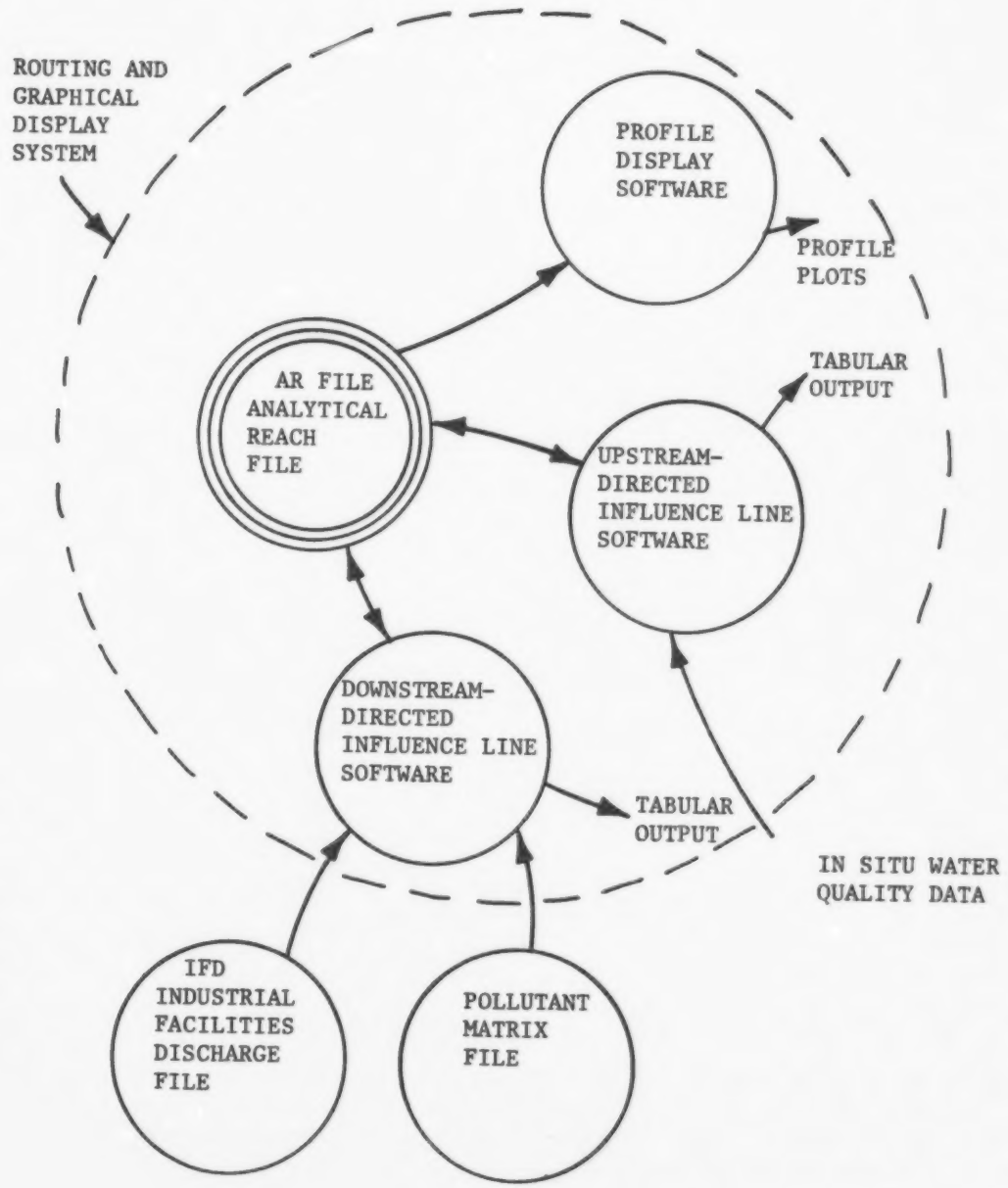


FIGURE VI - 2

RELATIONSHIP AMONG COMPONENTS OF THE ROUTING AND GRAPHICAL DISPLAY SYSTEM AND OTHER FILES IN THE DEMONSTRATION PROJECT

Source: Figure reproduced directly from Reference VI-2

currently contains information on approximately 68,000 stream reaches (i.e., a stretch of river uniquely defined by an upstream and downstream point) while the IFD contains information on approximately 45,000 industrial and municipal discharges.

Two simplified water quality models within RGDS directly access information from the files and calculate concentration within the stream network. A downstream directed model accepts loadings to the stream network as calculated from the IFD and PMF files and routes these pollutants through the network using a first order decay function. Flow values and time of travel estimates stored in the AR File are utilized in the routing. An upstream directed model starts at any point within the stream network with a user supplied concentration value and moving upstream from that point calculates the maximum concentration within the stream at any point that could result in the fixed downstream value assuming a user supplied decay coefficient.

Both models are purely steady-state models. The downstream routing model may theoretically be used to simulate any constituent utilizing the first order decay function. However, it is limited to constituents within the PMF to calculate loading which currently includes ten metals and phenol. In the work leading to the present study, the PMF was expanded, with the assistance of USEPA Effluent Guidelines Branch, to include selected organic constituents (Ref. VI-2). This expansion was not intended for general use but rather to assist in the demonstration of the RGDS. In this previous study, RGDS was utilized to route 11 constituents within the Lower Mississippi River under varying flow and decay conditions.

RGDS also supports several graphical display programs including shaded area plots, and plan and profile stream plots. An example plot showing the profile of pollutant concentrations generated by the routing program is present in Figure VI-3.

Water Quality Analysis Simulation Program (WASP)

The Water Quality Analysis Simulation Program (WASP) is a general purpose water quality model developed by Hydroscience (Ref. VI-3). The model is structured to provide the user with both specific routines and a flexible structure to allow a wide range of modeling capabilities.

Water bodies are respresented in WASP by interconnecting compartments. These compartments may be linked so as to permit one, two or three dimensional models. WASP is a time varying model in terms of both loading conditions, flow and exchange coefficients. Hydraulic calculations are not performed within WASP, and thus, the transport mechanisms, both advective and dispersive must be provided by the user. This data may be provided to the model by either interconnection with a hydraulic model or from field data.

A significant feature of the model is the flexibility provided the user in specifying the kinetic/reactive equations governing pollutant transformations and interactions. Simple linear relationships, interactive linear relationships or a wide range of non-linear interactive relationships may be selected or programmed by the user.

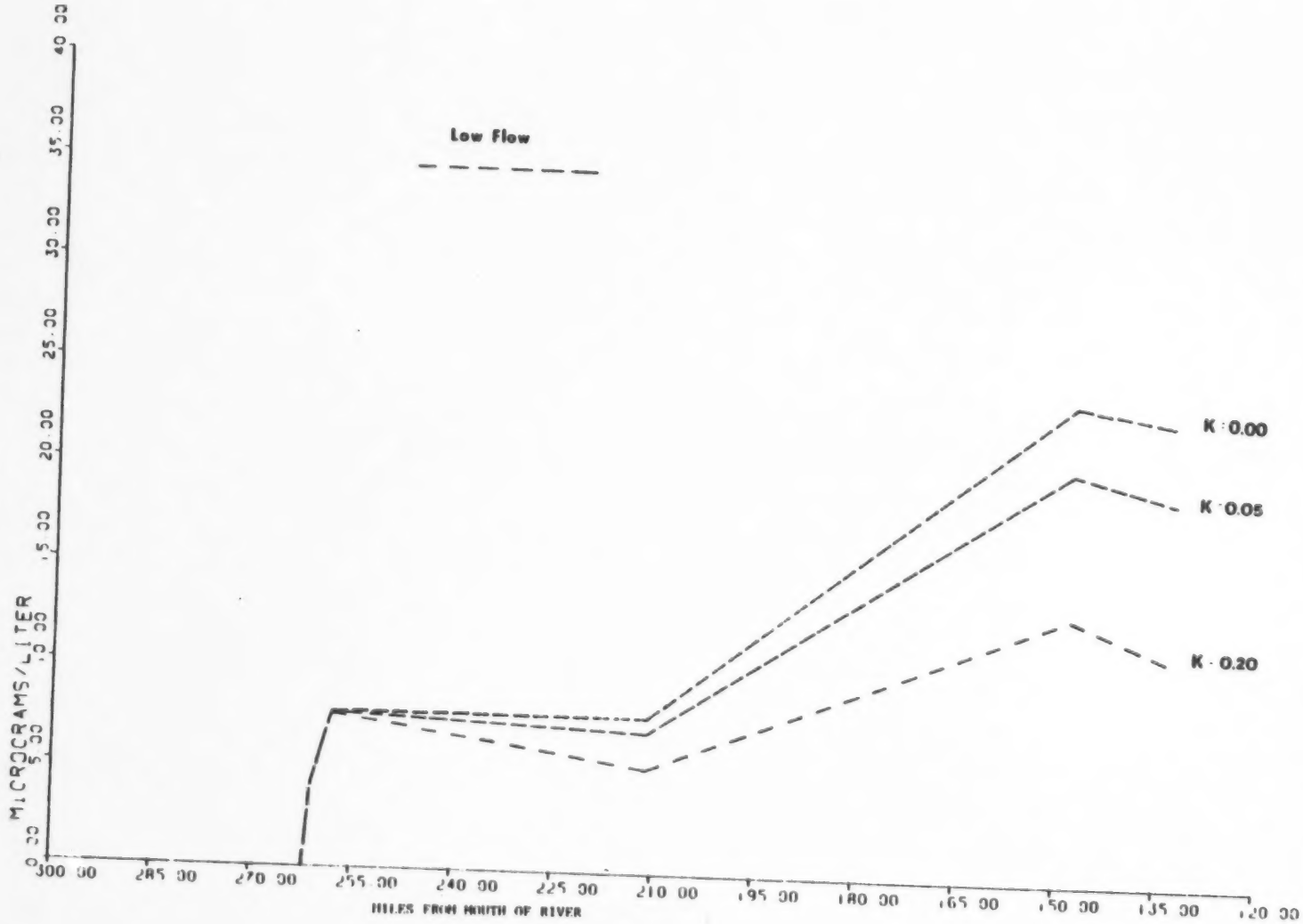


FIGURE VI - 3

EXAMPLE RGDS PROFILE PLOT

Source: Figure reproduced directly from Reference VI-2

WASP contains many attributes associated with a data-centered system. The data-centered aspects may be illustrated as in Figure VI-4, in which WASP may be interfaced with hydraulic models, graphical output routines, field data and a Model Verification Program (MVP) through a centralized file or files.

Exposure Analysis Modeling System (EXAMS)

The Exposure Analysis Modeling System (EXAMS) was developed by the USEPA Environmental Research Laboratory as a means of evaluating the ultimate (steady state) behavior of synthetic organic chemicals in aquatic ecosystems (Ref. VI-4). It was designed to provide information on chemical exposure (ultimate expected environmental concentrations), fate (distribution of the chemical in the system) and persistence (time required for effective purification of the system).

EXAMS combines loadings, transformations and transport into a set of differential equations by using the law of conservation of mass. A system is represented by a series of compartments which correspond to levels within the water column (littoral and benthic, epilimnion and hypolimnion in a lake) or to different 2-dimension locations. A wide range of transformations are represented including ionization, sorption, photolysis, hydrolysis, biolysis, oxidation and volatization. Hydraulic transport between compartments is through advection and dispersion.

The primary mode of operation of EXAMS is within an interactive computer environmment. An "English-language" command structure and a series of "help" commands guides the user through an interactive session. An example of such a session is presented in Figure VI-5.

TOXIWASP Model

TOXIWASP was developed by the USEPA Environmental Research laboratory in Athens, Georgia as a means of simulating the transport and fate of toxic chemicals in water bodies (Ref. VI-5). The model combines the chemical transformation processes adapted for the EXAMS model, the transport and program structure of the WASP model and a simple sediment balance algorithm. Like WASP, it is a dynamic model designed to operate in conjunction with a hydraulic model or other source of advective/diffusive flow information.

TOXIWASP represents the water bodies as a series of compartments. As illustrated in Figure VI-6, those compartments may be arranged to represent a wide range of configurations. Sediment is treated as a single size function that moves between compartments as illustrated in Figure VI-7 (a). Chemical transport and redistribution processes are illustrated in Figure VI-7 (b). Transformation processes explicitly represented in TOXIWASP include hydrolysis, photolysis, oxidation, biolysis, volatization and sorption onto sediment.

Since TOXIWASP is a hybrid of WASP, its structure is essentially identical. It displays many of the data centered modeling concepts of WASP and through modularity allows the user significant flexibility in modifying the kinetic representation. Because of the relatively complex transformation

FIGURE VI - 4

DATA CENTERED STRUCTURE OF WASP SYSTEM

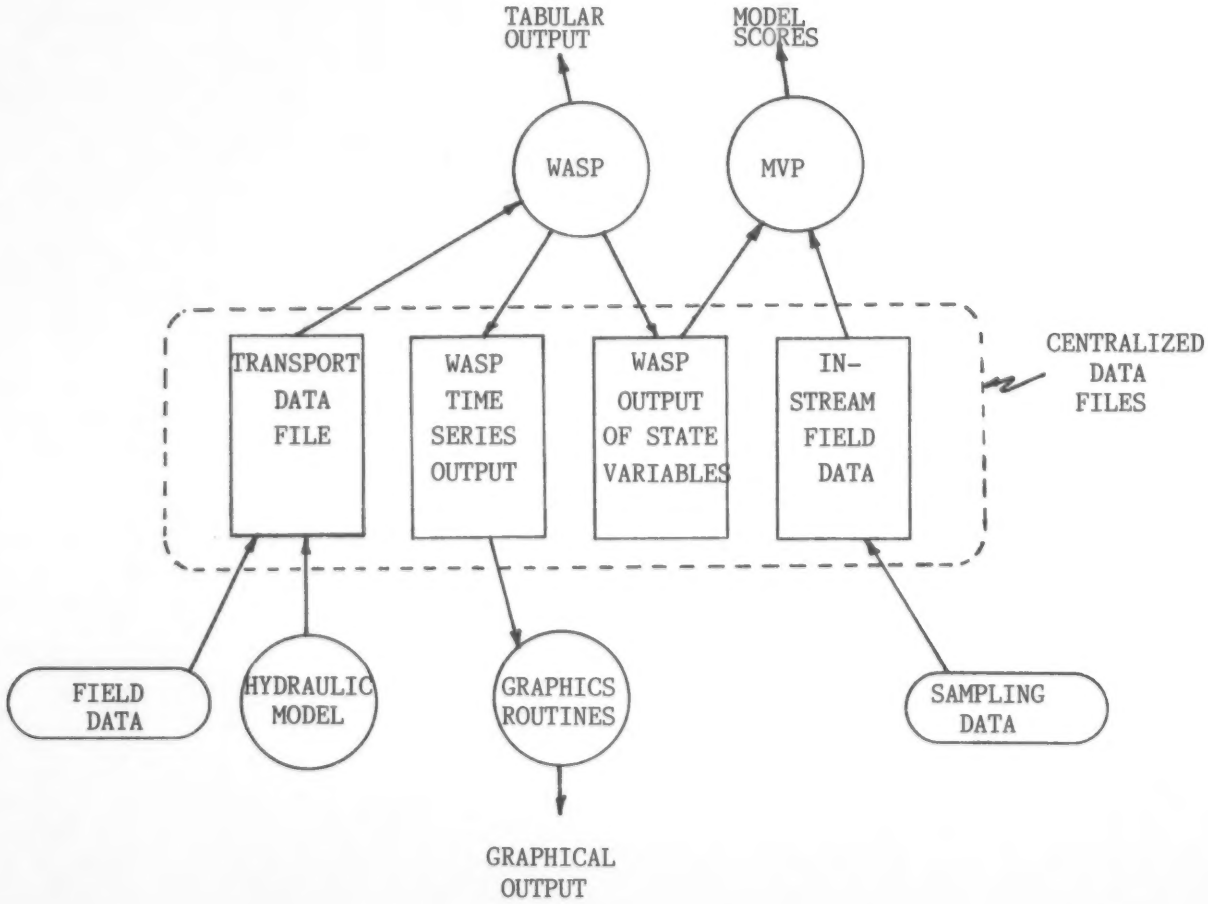


FIGURE VI - 5

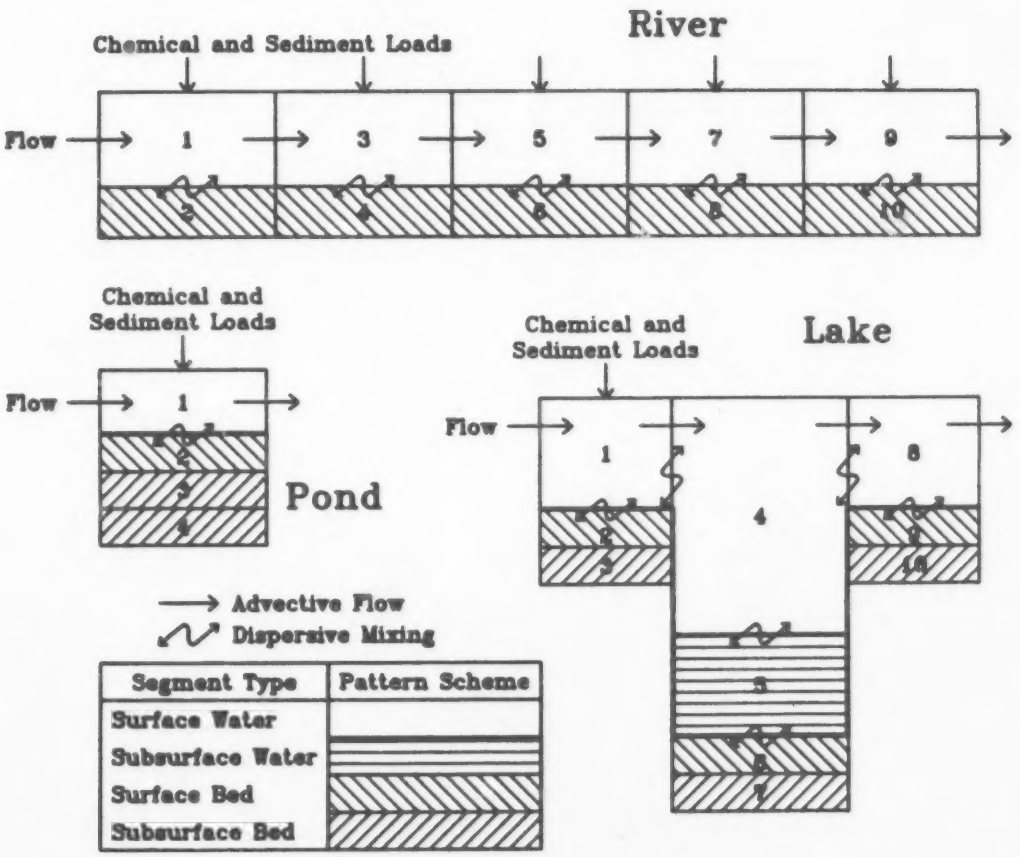
EXAMPLE INPUT COMMANDS FOR EXAMS

```
PDS> @TSO
User TSO  UIC[250,203] TT13: 14:50:50 11-JAN-81

PDS> RUN EXAMS
14:51:34
          Welcome to EXAMS
   EXposure Analysis Modeling System
Athens Environmental Research Laboratory
    Released for field trials Jan-81


The ATHENS collection of compounds is available for your use.


EXAMS > COMPOUND IS BFQ

Compound selected > BENZO[f]QUINOLINE

EXAMS > ENVIRONMENT IS EUTROPHIC LAKE

Selected environment is: EUTROPHIC LAKE, AERL DEVELOPMENT PHASE
                         TEST DEFINITION

EXAMS > CHANGE STRLD(1) TO 0.5

EXAMS > CHAN PCPLDG(1) TO 6.4E-03

EXAMS > CH PCPL(3) TO .032

EXAMS > CH PCP(6) TO 0.0064

EXAMS > CH IFLL(2) TO .02

EXAMS > CH IFLLDG(7) TO .02

EXAMS > CH NPSL(1) TO .16

EXAMS > CHANGE NPSLDG(6) TO 0.16

EXAMS > RUN

Simulation beginning for:
Compound: BENZO[f]QUINOLINE
Environment: EUTROPHIC LAKE, AERL DEVELOPMENT PHASE TEST
 DEFINITION
with a load of (kg/hr) >   0.904800

Run complete.

EXAMS > PRINT ALL

Requested report has been spooled to printer.

EXAMS > STOP
      Job433 -- STOP
14:57:19  Size: 32K   CPU: 22.35  Status: SUCCESS

PDS> LOGOUT
      User TSO  UIC [250,203] TT13: 14:48:00 11-JAN-81
CONNECT TIME 07 M  SYSTEM UTILIZATION 43 MCTS
```

Source: Figure reproduced directly from Reference VI-4

FIGURE VI - 6

Examples of TOXIWASP Network Configurations

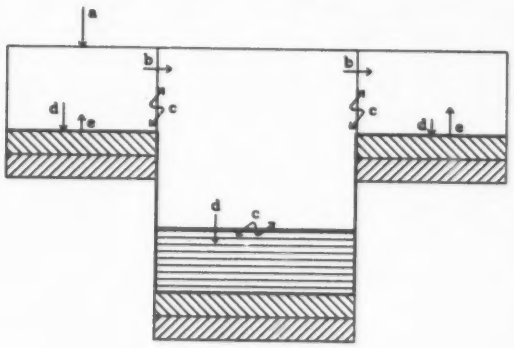


Source: Figure reproduced directly from Reference VI - 5

FIGURE VI - 7

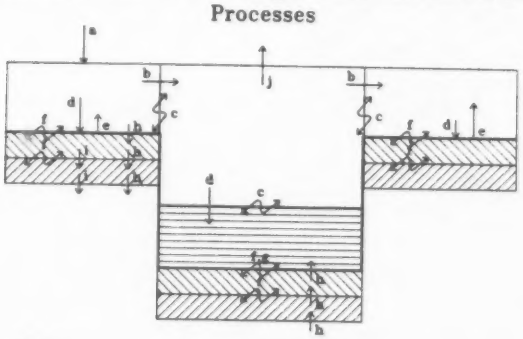
PROCESS REPRESENTATION BY TOXIWASP

A) **TOXIWASP Sediment Transport Processes**



Process	Segment Types
a) Mass Loading	1,2 to Water
b) Advection	1,2 Water-Water
c) Dispersion	1,2 Water-Water
d) Settling	1,2 Water-Water or Water-Bed
e) Erosion	3 Surface Bed-Water

B) TOXIWASP Chemical Transport and Redistribution Processes



Process	Segment Types
a) Mass Loading	1,2 to Water
b) Advection	1,2 Water-Water
c) Dispersion	1,2 Water-Water
d) Settling	1,2 Water-Water or Water-Bed
e) Erosion	3 Surface Bed-Water
f) Pore Water Diffusion	3,4 Surface Bed-Water or Bed-Bed
g) Sediment Turnover	3 Surface Bed-Water
h) Percolation	4 Bed-Bed or Bed-Water
i) Sedimentation	4 Bed-Bed
j) Volatilization	1 Surface Water

Source: Figure reproduced directly from Reference VI-5

processes represented in TOXIWASP, the parameterization (calibration) process for TOXIWASP is quite extensive.

Sediment Contaminant Transport Model SERATRA

SERATRA is a sediment contaminant transport model developed by Batelle Pacific Northwest Laboratories for USEPA (Ref. VI-6). It is an unsteady state, two dimensional (longitudinal and vertical) finite element model. The sediment-contaminant interaction is represented by three sub-models: a sediment transport sub-model, a dissolved contaminant transport sub-model and a particulate contaminant transport sub-model.

Within the sediment and particulate contaminant transport sub-models, three size fractions of sediments are simulated. The dissolved contaminant transport sub-model represents the adsorption/desorption interaction with sediment and degradation of dissolved contaminants due to hydrolysis, oxidation, volatization, photolysis, and biological activities.

SERATRA does not do hydrodynamic routing. Flow and depth values may be determined by linking SERATRA with a flow model or by using field measured values.

Other Water Quality Models

The previously described models are representative of the available models directed towards the simulation of organics in water bodies. Other models which were reviewed in the conduct of this study which have some potential utility, in whole or part, in the simulation of water quality in the Lower Mississippi River are listed below:

- Hydrologic Simulation Program - FORTRAN (HSPF) (Ref. VI-7)
- EXPLORE - 1 (Ref. VI-8)
- RECEIV - II (Ref. VI-9)
- MIT Transient Water Quality Network Model (Ref. VI-10)
- Water Quality for River-Reservoir Systems (WQRRS) (Ref. VI-11)
- Toxic Organic Substance Transport and Bioaccumulation Model (TOXIC) (Ref. VI-12)

Parameterization of Water Quality Models

In order to apply a water quality model to a specific situation, the "knobs and switches", i.e. the parameters of the model, must be adjusted so as the model will represent, to the degree possible, the results of the actual processes occurring within the water body. This process is generally known as parameterizing or calibrating the model.

The parameterization process generally encompasses both the selection of some parameters based on past experience or commonly accepted literature values and the further adjustment of these parameters or other parameters in order to match field data for the specific situation being modeled. As the complexity of the processes being modeled increases, the number of parameters

used in the modeling process multiplies and the cost of acquiring field data increases and, as is the case in modeling organics, the reliance upon generally accepted values or ranges of values for model parameters increases.

In the models previously reviewed or listed in this chapter, the number of parameters requiring values to be supplied by the modeler varies from only a few in the RGDS to a large number in models such as TOXIWASP. During the past five to ten years there has been extensive research performed that can assist in the parameterization. Two documents which serve as good reviews of much of the literature on the processes and their representative values and which contain representative values are described below:

1. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants (Ref. VI-13). This document prepared by Tetra Tech for USEPA describes a set of manual or simple calculator procedures and representative parameters for assessing the loading and fate of pollutants in streams, impoundments and estuaries. Many of these procedures are similar to those represented in the computer models and thus this document serves as both a primer on the methods and a source of values useful in the parameterization process.

2. Aquatic Fate Process Data for Organic Priority Pollutants (Ref. VI-14). This document developed by SRI International for USEPA contains representative transformation and rate constants for the 113 organic priority pollutants. Representative values and the source of the data are provided for the following properties:

   Physical properties and transport processes

   - Molecular weight
   - Melting point
   - Boiling point
   - Ionization constant
   - Partition constants
   - Volatilization constants

   Transformation process

   - Photolysis data
   - Oxidation rate constants
   - Hydrolysis rate constants
   - Biotransformation rate constant

Values are presented in a format and units comparable with those used by the EXAMS model.

The second form of information utilized in the parameterization of water quality models is field data collected from the area being modeled. Such data includes both measurements of the in-situ concentration of the constituents being modeled and laboratory measurements of rate constants of processes occurring within the water bodies.

Measurements of in-situ concentrations may be performed in either an Eulerian or Lagrangian framework. In the Eulerian framework, samples are taken at fixed reference points as the water body flows by. Most routine monitoring programs are conducted in this manner. In the Lagrangian framework, sampling is performed in a reference system moving with the flow of the river. This type of sampling is most useful in studying highly unsteady state situations and is generally associated with specific purpose stream studies. Data collected in both frameworks may be utilized in the parameterization process.

HYDRODYNAMIC MODELS

Water quality modeling requires information on the hydrodynamic transport mechanisms affecting the movement and dilution of pollutants within the water bodies. In most cases, for the water quality models described in the previous section, a separate means of supplying hydrodynamic transport information is required or a separate module is present within the models to provide such information.

The hydrodynamic information generally required by water quality models include time and spatial histories of flow, depths, velocity and dispersion. This information may be simulated utilizing several established hydrodynamic models or may be derived from direct measurement of instream parameters. Within the Lower Mississippi, the temporal and spatial variability of the required hydrodynamic parameters is relatively minimal thus minimizing the need for a highly dynamic model. Local dispersive transport processes, however, may have significant impact on the vertical and lateral mixing phenomena. Thus these characteristics should be considered in selecting a model or method of providing hydrodynamic information.

A large number of hydraulic models are available that may be used in whole or part to provide hydrodynamic information for the water quality modeling of the Lower Mississippi River. An example list of potential models is presented below:

- RECEIV II (Ref. VI-9)
- EXPLORE I (Ref. VI-8)
- HSPF (Ref. VI-7)
- WQRRS (Ref. VI-11)
- HEC-1 (Ref. VI-15)
- M.I.T. Transient Water Quality Network Model (Ref. VI-10)
- Gradually Varied Unsteady Flow Profiles (Ref. VI-16)

Determination of whether formal hydraulic modeling is required and/or selection of a specific hydraulic model for use on the Lower Mississippi River depends upon the specific circumstances selected for water quality modeling.

SUMMARY

A wide array of models and methods are available and may be refined based on available techniques for use in water quality modeling of the

lower Mississippi River. Water quality modeling requires two interacting components: hydraulic component and water quality component. The hydraulic component may be provided through modeling or through direct field measurements. Water quality models representing the transport and transformation of organic constituents are available. Source references providing representative rate coefficients utilized in such models are available and represent a starting point for the calibration of the models.

Data-centered modeling techniques such as is provided by the Routing and Graphical Display System (RGDS) and to some degree by the Water Quality Analysis Simulation Program (WASP) and its derivative TOXIWASP represent an integrated organized manner of handling data and models. This form of organization is of greatest utility where establishment of a systematic technique, as opposed to a one-time modeling application, is required.

REFERENCES

VI-1. W. E. Gates and Associates, "Reach File Enhancements: Pollutant Routing and Graphical Display Capabilities", USEPA, Washington, DC, 1982.

VI-2. Grayman, W. M., J. E. Sarsenski, P. J. Wehrman, R. D. Koch, "Conceptual Development of a Toxic Screening Model", W. E. Gates and Assoc., USEPA, Cincinnati, OH, 1984.

VI-3. DiToro, D. M., J. J. Fitzpatrick, R. V. Thomann, "Documentation for Water Quality Analyses Simulation Program (WASP) and Model Verification Program (MVP)", Hydroscience, Inc., USEPA, Duluth, EPA-600/3-81-044, May 1983.

VI-4. Burns, L. A., D. M. Cline, R. R. Lassiter, "Exposure Analysis Modeling System (EXAMS): User Manual and System Documentation", USEPA, Athens, GA, EPA-600/3-82-023, July 1982.

VI-5. Ambrose, R. B., S. J. Hill, L. A. Mulkey, "User's Manual for the Chemical Transport and Fate Model (TOXIWASP), Version 1", USEPA, Athen, GA, EPA-600/3-83-005, May 1983.

VI-6. Onishi, Y., S. E. Wisp, "Mathematical Model, SERATRA, for Sediment-Contaminant Transport in Rivers and It's Application to Pesticide Transport in Four Mile and Wolf Creeks in Iowa", Batelle Northwest Labs, USEPA, Athens, GA, EPA-600/3-82-045, August 1982.

VI-7. Donigian, A. S., et. al., "Application of Hydrologic Simulation Program - FORTRAN (NPF) in Iowa Agricultural Watersheds", USEPA, Athens, GA, EPA-600/53-83-069, Nov. 1983.

VI-8. Onishi, Y., "User's Manual for EXPLORE-I: A River Basin Water Quality Module (Hydraulic Module Only)", Batelle Northwest Labs., USEPA, Athens, GA, EPA-600/3-82-054, Sept. 1982.

VI-9. Raytheon Co., "New England River Basins Modeling Project, Final Report, Vol. III, Documentation Report, Part I, RECEIV-II Water Quality and Quality Model", USEPA, Washington, DC, December 1974.

VI-10. Harleman, D. R. F., "User's Manual for the M.I.T. Transient Water Quality Network Model", M.I.T., USEPA, Corvallis, OR, EPA-600/3-77-010, January 1977.

VI-11. Smith, D. J., "Water Quality for River-Reservoir Systems", Resouce Management Assoc., U.S. Army Corps of Engineers, HEC, Davis, CA, October 1978.

VI-12. Schnoor, J. L., et. al., "Verification of a Toxic Organic Substance Transport and Bioaccumulation Model", Univ. of Iowa, USEPA, Athens, GA, EPA-600/S2-83-007, April 1983.

VI-13. Mills, W. B., et. al., "Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants", Tetra Tech, USEPA, Athens, GA, EPA-600/6-82-004, September 1982.

VI-14. Mabey, W. R., "Aquatic Fate Process Data for Organic Priority Pollutants", SRI International, USEPA, Washington, DC, Final Draft Report, July 1981.

VI-15. Hydrologic Engineering Center, "HEC-1 Flood Hydrograph Package Users Manual", U.S. Army Corps of Engineers, HEC, Davis, CA, 723-X6-L2010, Sept. 1981.

VI-16. Hydrologic Engineering Center, "Gradually Varied Unstead Flow Profiles", U.S. Army Corps of Engineers, HEC, Davis, CA, Program 723-G2-L7450, June 1976.

APPENDIX A

ELEMENTS PRESENT IN THE LOWER MISSISSIPPI RIVER WATER QUALITY DATA BASE

NO.	ABBR.	NAME	UNITS	DESCRIPTION
001	DFLG	DELFLOG	GAL	DELTA FLOW, FLOW RATE (GPD)/24 HOUR PERIOD
002	CARV	CARVOLCF	CU.FT	CARBON BED VOLUME
003	TOC	TOC	MG/L	TOTAL ORGANIC CARBON, INST. READING - DOHRMAN
004	UV25	UV254		UV ABS., 254 NM ,UNITS ARE ABSORBANCE UNITS
005	EMF	EMF		EMISSION FLUORSCENCE,VALUE * 100 = CORRECT READING
006	RFM	RFM		RAPID FLUORESCENCE MEASUREMENT
007	ICHC	CHLROFRM	NG/L	CHLOROFORM, INST. READING
008	TA5C	TA5CL3F	NG/L	CHLOROFORM,TERM,STD 5 DAYS,FREE CL,TEMP=AMB,PH=AMB
009	TC5C	TC5CL3F	NG/L	CHLOROFORM,TERM,STD 5 DAYS,FREE CL,TEMP=30C,PH=10
010	TCHC	TA5CL3C	NG/L	CHLOROFORM,TERM,STD 5 DAYS,COMB CL,TEMP=AMB,PH=AMB
011	IBR1	BRDCLMET	NG/L	BROMODICHLOROMETHANE, INST. READING
012	TA5B	TA5BR1F	NG/L	BROMODICHLOROMETHANE,TERM,STD 5 DAYS,FREE CL,T=AMB,PH=AMB
013	TC5B	TC5BR1F	NG/L	BROMODICHLOROMETHANE,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
014	T5BR	TA5BR1C	NG/L	BROMODICHLOROMETHANE,TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
015	IBR2	CLDBRMET	NG/L	CHLORODIBROMOMETHANE, INST. READING
016	TA52	TA5BR2F	NG/L	CHLORODIBROMOMETHANE,TERM,STD 5 DAYS,FREE CL,T=AMB,PH=AMB
017	TC52	TC5BR2F	NG/L	CHLORODIBROMOMETHANE,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
018	T5B3	TA5BR2C	NG/L	CHLORODIBROMOMETHANE,TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
019	IBR3	BROMOFRM	NG/L	BROMOFORM, INST. READING
020	TA53	TA5BR3F	NG/L	BROMOFORM, TERM, STD 5 DAYS,FREE CL, TEMP=AMB, PH=AMB
021	TC53	TC5BR3F	NG/L	BROMOFORM, TERM, STD 5 DAYS, FREE CL, TEMP=30C,PH=10
022	T5B4	TA5BR3C	NG/L	BROMOFORM, TERM, STD 5 DAYS,COMB CL, TEMP=AMB, PH=AMB
023	DCET	DCETAN	NG/L	DICHLOROETHANE-1,2 ,INST. READING
024	TADC	TA5DCETF	NG/L	DICHLOROETHANE-1,2 ,TERM,STD 5 DAYS,FREE CL,T=AMB,PH=AMB
025	TCDC	TC5DCETF	NG/L	DICHLOROETHANE-1,2 ,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
026	TDCE	TA5DCETC	NG/L	DICHLOROETHANE-1,2 ,TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
027	BENZ	BENZENE	NG/L	BENZENE, INST. READING
028	TABN	TA5BENZF	NG/L	BENZENE,TERM,STORED 5 DAYS,,COMBINED CL,,TEMP=AMB, PH=AMB
029	TCBN	TC5BENZF	NG/L	BENZENE, TERM, STORED 5 DAYS, FREE CL, TEMP=30C, PH=10
030	TBNC	TA5BENZC	NG/L	BENZENE, TERM, STORED 5 DAYS,COMBINED CL, TEMP=AMB PH=AMB
031	TOLU	TOLUENE	NG/L	TOLUENE, INST. READING
032	TATO	TA5TOLUF	NG/L	TOLUENE, TERM, STD 5 DAYS, FREE CL, TEMP=AMB, PH=AMB
033	TCTO	TC5TOLUF	NG/L	TOLUENE, TERM, STD 5 DAYS, FREE CL, TEMP=30C, PH=10
034	TTOL	TA5TOLUC	NG/L	TOLUENE, TERM, STD 5 DAYS, COMB CL, TEMP=ANB,PH=AMB
035	TRCE	TRCETEN	NG/L	TRICHLOROETHENE(ALSO TRICHLORCETHYLENE), INST. READING
036	TATR	TA5TRCEF	NG/L	TRICHLOROETHENE,TERM,STD 5 DAYS,FREE CL,T=AMB, PH=AMB
037	TCTR	TC5TRCEF	NG/L	TRICHLOROETHENE,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
038	TTRC	TA5TRCEC	NG/L	TRICHLOROETHENE,TERM,STD 5 DAYS,COMB CL,T=AMB, PH=AMB
039	TRC2	2TRCETAN	NG/L	TRICHLOROETHANE-1,1,2 ,INST. READING
040	TAT2	TA52C3EF	NG/L	TRICHLOROETHANE-1,1,2,TERM,STD 5 DYS,FREE CL,T=AMB,PH=AMB
041	TCT2	TC52C3EF	NG/L	TRICHLOROETHANE-1,1,2,TERM,STD 5 DYS,COMB CL,T=30C,PH=10
042	TTR2	TA52C3EC	NG/L	TRICHLOROETHANE-1,1,2,TERM,STD 5 DYS,COMB CL,T=AMB,PH=AMB
043	TCME	TCLMETAN	NG/L	TETRACHLOROMETHANE, INST. READING
044	TATC	TA5TCMTF	NG/L	TETRACHLOROMETHANE, TERM, STD 5 DAYS,FREE CL,T=AMB,PH=AMB
045	TCTC	TC5TCMTF	NG/L	TETRACHLOROMETHANE, TERM, STD 5 DAYS,FREE CL,T=30C,PH=10
046	TTCM	TA5TCMTC	NG/L	TETRACHLOROMETHANE, TERM, STD 5 DAYS,COMB CL,T=AMB,PH=AMB
047	DCME	DCMETAN	NG/L	DICHLOROMETHANE, INST. READING
048	TAD3	TA5DCMAF	NG/L	DICHLOROMETHANE,TERM,STD 5 DAYS,FREE CL,T=AMB,PH=AMB
049	TDCM	TA5DCMAC	NG/L	DICHLOROMETHANE,TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
050	BRCM	BRCLMETH	NG/L	BROMOCHLOROMETHANE, INST. READING

NO.	ABBR.	NAME	UNITS	DESCRIPTION
051	TAB4	TA5BCMNF	NG/L	BROMOCHLOROMETHANE,TERM,STD 5 DAYS, COMB CL,T=AMB,PH=AMB
052	TCBR	TC5BCMNF	NG/L	BROMOCHLOROMETHANE,TERM,STD 5 DAYS, COMB CL,T=30C,PH=10
053	TBRC	TA5BCMNC	NG/L	BROMOCHLOROMETHANE, TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
054	DCE2	DCLETHYL	NG/L	DICHLOROETHYLENE(ALSO CIS-1,2-DICHLOROETHENE),INST.READNG
055	TAD5	TA5DCEYF	NG/L	DICHLOROETHYLENE,TERM,STD 5 DAYS,FREE CL, T=AMB,PH=AMB
056	TDC4	TC5DCEYF	NG/L	DICHLOROETHYLENE,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
057	TDC5	TA5DCEYC	NG/L	DICHLOROETHYLENE,TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
058	CLPB	CLPBNZ	NG/L	CHLOROBENZENE, INST. READING
059	TACL	TA5CLBZF	NG/L	CHLOROBENZENE,TERM,STD 5 DAYS,FREE CL, TEMP=AMB, PH=AMB
060	TCCL	TC5CLBZF	NG/L	CHLOROBENZENE, TERM,STD 5 DAYS,FREE CL, TEMP=30C,PH=10
061	TCL5	TA5CLBZC	NG/L	CHLOROBENZENE,TERM,STD 5 DAYS,COMB CL, TEMP=AMB, PH=AMB
062	DCBN	MDICLBNZ	NG/L	DICHLOROBENZENE-META, INST. READING
063	TAD4	TA5MDCBF	NG/L	DICHLOROBENZENE-META,TERM,STD 5 DAYS,FREE CL,T=AMB,PH=AMB
064	TCD3	TC5MDCBF	NG/L	DICHLOROBENZENE-META,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
065	TDCB	TA5MDCBC	NG/L	DICHLOROBENZENE-META,TERM,STD 5 DAYS,COMB CL,T=AMB,PH=AMB
066	ABHC	ABHC	NG/L	HEXACHLOROCYCLOHEXANE ALPHA BENZENE HEXACHLORIDE
067	BBHC	BBHC	NG/L	HEXACHLOROCYCLOHEXANE BETA BENZENE HEXACHLORIDE
068	GBHC	GBHC	NG/L	HEXACHLOROCYCLOHEXANE GAMMA BENZENE HEXACHLORIDE
069	HXCL	HXCLRBNZ	NG/L	HEXACHLOROBENZENE, INST. READING
070	HEPT	HEPTACLR	NG/L	HEPTACHLOR, INST. READING
071	ACHL	ACHLRDEN	NG/L	ALPHA CHLORDENE, INST. READING
072	BCHL	BCHLRDEN	NG/L	BETA CHLORDENE, INST. READING
073	GCHL	GCHLRDEN	NG/L	GAMMA CHLORDENE, INST. READING
074	ALDR	ALDRIN	NG/L	ALDRIN, INST. READING
075	HEPC	HEPCLREP	NG/L	HEPTACHLOR EPOXIDE, INST. READING
076	ACH2	ACHLRDAN	NG/L	ALPHA CHLORDANE, INST. READING
077	GCH2	GCHLRDAN	NG/L	GAMMA CHLORDANE, INST. READING
078	24DD	24DDE	NG/L	ORTHO, PARA'-DDE, INST. READING
079	44DD	44DDE	NG/L	PARA, PARA'-DDE, INST. READING
080	ENDS	ENDSULF1	NG/L	ENDOSULFAN-1, INST. READING
081	END2	ENDSULF2	NG/L	ENDOSULFAN-2, INST. READING
082	DIEL	DIELDRIN	NG/L	DIELDRIN, INST. READING
083	24D3	24DDD	NG/L	ORTHO, PARA'-DDD, INST. RREADING
084	44D3	44DDD	NG/L	PARA, PARA'-DDD, INST READING
085	ENDR	ENDRIN	NG/L	ENDRIN, INST. READING
086	24DT	24DDT	NG/L	ORTHO, PARA'-DDT, INST. READING
087	44DT	44DDT	NG/L	PARA, PARA'-DDT, INST. READING
088	PHOT	PHOTDIEL	NG/L	PHOTODIELDRIN, INST. READING
089	METH	METHOCLR	NG/L	METHOXYCHLOR, INST. READING
090	MIRE	MIREX	NG/L	MIREX, INST. READING
091	B2ET	B2ETLHPH	NG/L	BIS (2 ETHYL HEXYL) PHTHALATE, INST. READING
092	NDEC	NDECANE	NG/L	DECANE-N, INST. READING
093	NUND	NUNDECAN	NG/L	UNDECANE-N, INST. READING
094	NDOD	NDODECAN	NG/L	DODECANE-N, INST. READING
095	NTRI	NTRIDEC	NG/L	TRIDECANE-N, INST. READING
096	NTET	NTETRDEC	NG/L	TETRADECANE-N, INST. READING
097	NPEN	NPENTDEC	NG/L	PENTADECANE-N, INST. READING
098	NITR	NITROBNZ	NG/L	NITROBENZENE, INST. READING
099	ISOP	ISOPHORO	NG/L	ISOPHORONE, INST. READING
100	BIPH	BIPHENYL	NG/L	BIPHENYL,INST. READING

NO.	ABBR.	NAME	UNITS	DESCRIPTION
101	DMEL	DMELPHTH	NG/L	DIMETHYL PHTHALATE, INST. READING
102	ACEN	ACENAPHE	NG/L	ACENAPHTHENE, INST. READING
103	DETL	DETLPHTH	NG/L	DIETHYL PHTHALATE, INST. READING
104	FLUO	FLUORENE	NG/L	FLUORENE, INST. READING (PAH)
105	ATRA	ATRAZINE	NG/L	ATRAZINE,INST. READING
106	DPRO	DPROPHTH	NG/L	DIPROPYL PHTHALATE, INST. READING
107	PHEA	PHEANREN	NG/L	PHENANTHRENE, INST. READING (PAH)
108	ANTR	ANTRACEN	NG/L	ANTHRACENE, INST. READING
109	DIBL	DIBLPHTH	NG/L	DI-ISOBUTYL PHTHALATE, INST. READING
110	DNBL	DNBLPHTH	NG/L	DI N-BUTYL PHTHALATE, INST. READING
111	TRPH	TRPHYLMT	NG/L	TRIPHENYLMETHANE, INST. READING
112	FLOR	FLORANEN	NG/L	FLUORANTHENE, INST. READING (PAH)
113	PYRE	PYRENE	NG/L	PYRENE, INST. READING (PAH)
114	CO3	CARBONAT	MG/L	CARBONATES, INST. READING
115	HCO3	BICARBON	MG/L	BICARBONATES,INST. READING
116	CALC	CALCIUM	MG/L	CALCIUM, INST. READING
117	TOT.	TOT.HARD	MG/L	TOTAL HARDNESS
118	PH	PH		INITIAL PH SAMPLE
119	TURB	TURB	NTU	NTU-NEPHELOMETRIC TURBIDITY UNITS, INST. READING
120	CLTO	CLTOTAL	MG/L	TOTAL CHLORINE RESIDUAL- ORTHOTOLIDENE
121	TDS	TDS	MG/L	TOTAL DISSOLVED SOLIDS
122	TSS	TSS	MG/L	TOTAL SUSPENDED SOLIDS
123	COLI	TOT.COLI		TOTAL COLIFORMS COUNTS/100 ML
124	SPC	SPC	CT/ML	TOTAL BACTERIA PLATE COUNT
125	TEMP	TEMPSAMP	C	TEMPERATURE OF SAMPLE
126	TCET	TCETEN	NG/L	TETRACHLOROETHYLENE, INST. READING
127	TAT5	TA5TCETF	NG/L	TETRACHLOROETHYLENE, TERM,STD 5 DAYS,FREE CL,T=AMB,PH=AMB
128	TCT4	TC5TCETF	NG/L	TETRACHLOROETHYLENE, TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
129	ECTO	ECDTOAR		ELECTRON CAPTURE - SUM OF ALL PEAK AREAS IN CHROMATOGRAM
130	FIDT	FIDTOAR		FLAME IONIZATION, SUM OF PEAK AREAS IN CHROMATOGRAM
131	CLET	CLRETHYL	NG/L	CHLOROETHYLENE, INST. READING
132	TAC5	TA5CLELF	NG/L	CHLOROETHYLENE,TERM, STD 5 DAYS, FREE CL, T=AMB, PH=AMB
133	TCC2	TC5CLELF	NG/L	CHLORDETHYLENE,TERM, STD 5 DAYS, FREE CL, T=30C, PH=10
134	TECE	TCLRETAN	NG/L	TETRACHLOROETHANE-1,1,2,2 ,INST. READING
135	TAEC	TA5CL4EF	NG/L	TETRACHLOROETHANE-1,1,2,2;TERM,STD 5D,FR CL,T=AMB,PH=AMB
136	TCEC	TC5CL4EF	NG/L	TETRACHLOROETHANE-1,1,2,2,TERM,STD 5D,FR CL,T=30C,PH=10
137	PCLR	PCLRNBNZ	NG/L	PENTACHLORONITROBENZENE, INST. READING
138	DCPA	DCPA	NG/L	DIMETHYL-2,3,5,6-TETRACHLOROTERE PHTHALATE
139	OXCH	OXCHLDAN	NG/L	OXY-CHLORDAN, INST. READING
140	34DD	34DDD	NG/L	META, PARA'-DDD, INST. READING
141	PERT	PERTHANE	NG/L	PERTHANE, INST. READING
142	BNZN	BNZNITRL	NG/L	BENZONITRILE,INST. READING
143	BNZY	BNZYCYAN	NG/L	BENZYL CYANIDE, INST. READING
144	2NIT	2NITRTOL	NG/L	NITROTOLUENE-2, INST. READING
145	ETBN	ETLBNZ	NG/L	ETHYL BENZENE, INST. READING
146	NPTH	NPTHALEN	NG/L	NAPHTHALENE, INST. READING (PAH)
147	CLRN	CLRNIBNZ	NG/L	1-CHLORO-2NITROBENZENE (ALSO CHLORONITROBENZENE-ORTHO)
148	MET3	METHNAPH	MG/L	METHYLNAPHTHALENE, INST. READING
149	ACNP	ACNPTHON	NG/L	ACENTONAPHTHONE-2', INST. READING
150	NHEX	NHEXADEC	NG/L	HEXADECANE-N, INST. READING

NO.	ABBR.	NAME	UNITS	DESCRIPTION
151	NHEP	NHEPTDEC	NG/L	HEPTADECANE-N
152	NOCT	NOCTADEC	NG/L	OCTADECANE-N, INST. READING
153	NNON	NNONDECA	NG/L	NONADECANE-N, INST. READING
154	NEIC	NEICOSAN	NG/L	EICOSANE-N, INST. READING
155	FEC.	FEC.COLI		FECAL COLIFORMS COUNTS/100 ML
156	DO2	DO2	MG/L	DISSOLVED OXYGEN, INST. READING
157	TCD5	TC5DCMAF	NG/L	DICHLOROMETHANE,TERM,STD 5 DAYS,FREE CL,T=30C,PH=10
162	5TMA	TA5TTHMF	UG/L	TRIHALOMETHANE, TERM, STD 5 DAYS,FREE CL,TEMP=AMB
163	5TMC	TC5TTHMF	UG/L	TRIHALOMETHANE, TERM, STD 5 DAYS,FREE CL, CONSTANT TEMP
164	ITHM	TTHM	UG/L	TRIHALOMETHANE, INST. READING
165	ACVL	ACARVOL	CU.FT	AVERAGE CARBON VOLUME DURING PHASE
166	CWVP	CARBWTVP	LBS	AVE. CARBON WEIGHT DURING EACH PHASE
167	CWVK	CARBWTVK	KG	AVE. CARBON WEIGHT DURING EACH PHASE,LOSSES IN EACH PHASE
168	CWVG	CARBWTVG	GRAMS	CARBON WEIGHT IN PILOT COLUMNS
169	SFLG	SUMFLOG		SUMMATION FLOW, U.S. GALLONS
170	SFLL	SUMFLOL		SUMMATION FLOW, LITERS
171	SFLM	SUMFLOMG		SUMMATION FLOW, MILLION GALLONS
172	SFLT	SUMFLOTG		SUMMATION FLOW, (1000 GALLONS)
180	ACRO	ACROLEIN	NG/L	ACROLEIN
181	ACRY	ACRYLNTL	NG/L	ACRYLONITRILE
182	BRME	BROMMETH	NG/L	BROMOMETHANE
183	CHET	CHLORETH	NG/L	CHLOROETHANE
184	2CVE	2CHLVINE	NG/L	2-CHLOROETHYL VINYL ETHER
185	CHME	CHLORMET	NG/L	CHLOROMETHANE
186	11DA	11DICHEA	NG/L	1,1-DICHLOROETHANE
187	11DE	11DICLEE	NG/L	1,1-DICHLOROETHENE
188	12DP	12DICHLP	NG/L	1,2-DICHLOROPROPENE
189	C13D	C13DICHP	NG/L	C-1,3-DICHLOROPROPENE
190	T13D	T13DICHP	NG/L	T-1,3-DICHLOROPROPENE
191	111T	111TRCHE	NG/L	1,1,1-TRICHLOROETHANE
201	FLOW	QFLOWCFS	CFS	DAILY STREAMFLOW
202	SSOL	SUSSOLID	MG/L	SUSPENDED SOLIDS

APPENDIX B

WATER QUALITY DATA FILE FORMATS

A series of nine data files containing water quality data on the lower Mississippi River were established as part of this project. A common format was utilized, as described below, for all files.

Elements		Columns
Source Code	(A)	1-2
Observation Number	(B)	4-8
Station Number	(C)	10-11
Sub-Station Number	(D)	13-14
Year	(E)	16-17
Day Number	(F)	19-21
Constituent Number	(G)	23-25
River Mile	(H)	27-32
"Less than" Code	(I)	34
Value	(J)	36-47

EXPLANATIONS

A) Source Code
Two Digit Code XY
X = Agency developing data
Y = Mechanism by which data acquired

X = 1 - Jefferson Parish data
Y = 1 Acquired from EPA project data base
Y = 2 Acquired in computer compatible form from EPA Region VI
Y = 3 Acquired direcly from Jefferson Parish

X = 2 - New Orleans data
Y = 1 Acquired directly from New Orleans
Y = 2 Acquired in computer compatible form from EPA Region VI

X = 3 - Lousiana Department of Natural Resources (LDNR) data
Y = 1 Acquired from LDNR

X = 5 - U.S. Geological Survey/Corps or Engineers data
Y = 1 Acquired from published USGS reports
Y = 2 Unpublished information from Corps of Engineers

B) Observation Number

A sequential number for each observation. Only present if original data was so numbered.

C) Station Number

1-12 LDNR stations MR01 to MR12
21 Jefferson Parish
31 New Orleans
41 Tarbert Landing, MS

D) Sub-Station Number (lateral position)

0 Midstream or unknown
1 Near left bank
2 Near right bank
3 Midway between left bank and mid stream
4 Midway between right bank and mid stream

E) Year

2-digit code (i.e. 81 = 1981)

F) Day Number

Sequentital day number within each year
1 = January 1

G) Constituent Number

See Appendix A for correspondence

H) River Mile

Miles above Head of Passes

J) "Less than" Code

A "1" indicates that data has been reported as "less than" given value. A "0" indicates that data is equal to given value.

J) Value

Value of constituent. See Appendix A for units of value.